

PROJECT MANUAL



CAPE FEAR HARNETT CANCER CENTER (FIT UP)

215 BRIGHTWATER DRIVE
LILLINGTON, NC 27546

CONSTRUCTION DOCUMENTS

NOVEMBER 3, 2023






434 FAYETTEVILLE STREET
SUITE 1700
RALEIGH, NC 27601
PHONE: 919.829.2700

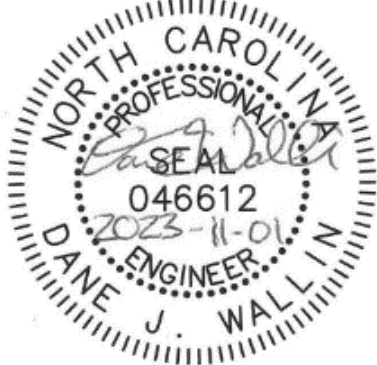
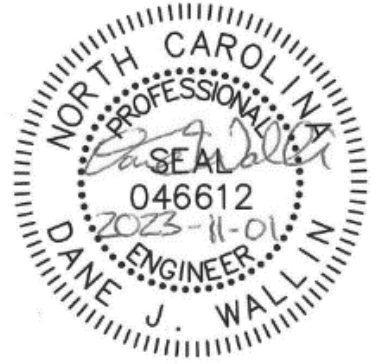
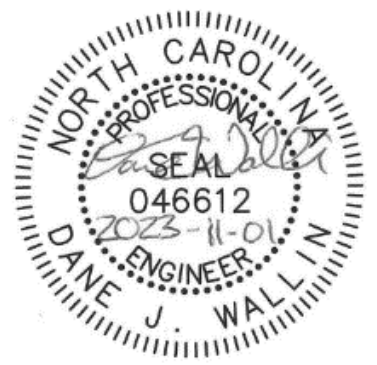

LS3P COMMISSION NUMBER: 8403-225630

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DOCUMENT 000107 – PROJECT DIRECTORY AND SEALS PAGES

ARCHITECTURE FIRM	LS3P ASSOCIATES LTD. Corporate License #50417 434 Fayetteville Street, Suite 1700 Raleigh, NC 27601 919.829.2700	
ARCHITECT	Jeffery R. Mural, AIA License #13432 434 Fayetteville Street, Suite 1700 Raleigh, NC 27601 919.829.2700	
TELECOMMUNICATIONS	John Reese, P.E. License #047740 McKim & Creed 1730 Varsity Drive Venture IV Building, Suite 500 Raleigh, NC 27606 919.233.8091	

<p>FIRE PROTECTION ENGINEER</p>	<p>Dane J. Wallin, P.E. License #046612 McKim & Creed 1730 Varsity Drive Venture IV Building, Suite 500 Raleigh, NC 27606 919.233.8091</p>	
<p>PLUMBING ENGINEER</p>	<p>Dane J. Wallin, P.E. License #046612 McKim & Creed 1730 Varsity Drive Venture IV Building, Suite 500 Raleigh, NC 27606 919.233.8091</p>	
<p>MECHANICAL ENGINEER</p>	<p>Dane J. Wallin, P.E. License #046612 McKim & Creed 1730 Varsity Drive Venture IV Building, Suite 500 Raleigh, NC 27606 919.233.8091</p>	
<p>ELECTRICAL ENGINEER</p>	<p>Jesse C. Alonzo, Jr. License #053121 McKim & Creed 1730 Varsity Drive Venture IV Building, Suite 500 Raleigh, NC 27606 919.233.8091</p>	

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BIDDER'S REQUEST FOR INFORMATION FORM

Project: Cape Fear Harnett Cancer Center (Fit Up)

LS3P Project #8403-225630

To: LS3P Associates LTD.
434 Fayetteville St., Suite 1700
Raleigh, NC 27601

Requested By: _____
Firm: _____
Phone No.: _____
Date: _____

E-Mail: danharrop@ls3p.com
Attn: Dan Harrop, AIA

Related Section and Paragraph No.: _____
Related Drawings/Details: _____

Bidder's Inquiry:

Signed:

Response:

Architect's response will be issued by formal Addendum.

Signed:

Date:

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Owner-furnished/Contractor-installed (OFICI) products.
4. Owner-furnished/Owner-installed (OFOI) products.
5. Contractor-furnished/Owner-installed (CFOI) products.
6. Contractor's use of site and premises.
7. Work restrictions.
8. Specification and Drawing conventions.

1.2 PROJECT INFORMATION

- A. Project Identification: The Keith Corporation – Cape Fear Harnett Cancer Center (Fit Up); LS3P Project Number 8403-225630.
 1. Project Location: 215 Brightwater Drive, Lillington, North Carolina 27546.
- B. Owner: The Keith Corporation.
- C. Architect: LS3P Associates Ltd., 434 Fayetteville Street, Suite 1700, Raleigh, North Carolina 27601; Phone: 919.829.2700.
 1. Architect's Representative: Dan Harrop, AIA.
- D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:
 1. Structural Engineer.: Moore Lindner Engineering.
 - a. Representative: Matt Lindner, P.E. | 704.321.1266 | Email: mlindner@moorelindner.com.
 2. Fire Protection, Plumbing, Mechanical, and Electrical Engineers: McKim & Creed, Inc.
 - a. Representative: Dane Wallin, P.E. | 919.233.8091 | Email: dwallin@mckimcreed.com
- E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Interior fit-up for a medical office building for Cape Fear Valley Health tenants. Building will be 3 stories, containing approximately 65K gross square feet. Occupancy will be medical office space; building construction Type IIB.

- B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.
 - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

- B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

- C. Owner-Furnished/Contractor-Installed (OFCI) Products:

- | | | |
|----|------|---------------------------------------|
| 1. | ND1 | Sanitary Napkin Disposal |
| 2. | PT | Paper Tower Dispenser |
| 3. | SHRP | Disposal, Sharps, Wall Mounted |
| 4. | SCL2 | Wheelchair Scale |
| 5. | HS | Dispenser, Hand Sanitizer, Wall Mount |

6.	OTS	Exam, Otoscope
7.	PYXIS	Dispenser, Medication
8.	GL	Supplies, Glove Dispenser, 3 Box
9.	ICE	On Counter Ice Maker, Plumbed
10.	EXTBL	Exam Table
11.	XRAY	Xray Machine
12.	E-CH	Adjustable Exam Chair, Power Req.
13.	OB	Ortho Exam Table
14.	COFF2	Coffee Maker – Plumbed
15.	SD	Soap Dispenser
16.	LINAC1	TrueBeam Couch
17.	LINAC2	TrueBeam Stand
18.	TV	Flat Screen Tv

1.5 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS

A. The Owner will furnish and install products indicated.

B. Owner-Furnished/Owner-Installed (OFOI) Products:

1.	WM1	Computing, Workstation, Small Form Tower, Wall Mounted
2.	FRG1	Undercounter Refrigerator
3.	COFF1	Coffee Maker, Plumbed
4.	ICE	Undercounter Ice Maker
5.	TRDM	Treadmill
6.	MEDF2	Meds Refrigerator
7.	HAM1	Hamper, Linen
8.	STR	Stretcher
9.	IV1	IV Stand
10.	SCL1	Stand-On Scale
11.	STL	Stool
12.	BW1	Blanket Warmer
13.	CRSH	Cart, Crash
14.	HMPR1	Cart, Hamper, Linen
15.	HMPR2	Cart, Supply, Linen, 60-inch
16.	WOW	Computing, Screener, Rolling Station
17.	CD1	Wall Mounted Computer
18.	WMM	Monitor (Wall Mount)
19.	ZPRT	Label Printer
20.	PTC1	Scale, Stand On
21.	US	Scanner (Ultrasound)
22.	SHLV 2	Shelving, Wire, Chrome, 48
23.	LBTBL	Lab Table
24.	WCH	Wheelchair, Stacking
25.	BWST	Biohazard Waste
26.	HZB	Meds Waste Container
27.	WBIN	Waste Container, 32-36 Gallon
28.	WB	Waste Container, Swing Top
29.	USM	Ultrasound Machine
30.	DC12	PC - Dual Screen

31.	CDT	Wall Mount Computer Tower
32.	COMPL	Laptop
33.	CDK	Computer Keyboard
34.	CDM	Computer Mouse
35.	PRT	Desktop Printer
36.	VEND	Vending Machine
37.	CP1	Commercial Copy Machine
38.	RACK	Wall Mounted Rack for Lead Lined Apron
39.	PBCH	Blood Draw Chair Model #66099b
40.	KSK	J2S Agrigento Kiosk With 27 Inch Display and Sanitizing Gel Dispenser.
41.	CF	Centrifuge
42.	HOOD	Pharmacy Fume Hood
43.	WSTE	Waste Container
44.	BW1	Full Height Blanket Warmer
45.	CASE M	Case Machine
46.	BIN	Meds Storage Bins

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.7 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 7:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
- C. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Architect not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Architect's written permission before proceeding with disruptive operations.
- D. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Project site is not permitted.
- E. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication, or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.

- g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance:
 - 1) During Bid Phase: Addenda.
 - 2) During Construction: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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DOCUMENT 012500.1 – CONTRACTOR’S REQUEST FOR SUBSTITUTION FORM

Project: Cape Fear Harnett Cancer Center (Fit Up) Project No.: 8403-225630
To: LS3P Associates LTD. Specification Section #: _____
434 Fayetteville St., Suite 1700, Raleigh, NC
27601 Contractor: _____
Attn.: Dan Harrop, AIA Requested by: _____
Phone: 919.829.2700 Phone: _____
Fax: 919.829.2730 Fax: _____
Email: danharrop@ls3p.com Email: _____

Reason for not providing specified item: _____

Savings to Owner for accepting substitution: _____

Specified Product/Fabrication Method
(List name/description; model no.; manufacturer): _____

Required Information for <i>Specified</i> Product:	Attached:
Point by Point Comparative Product Data	<input type="checkbox"/>
Tests	<input type="checkbox"/>
Reports	<input type="checkbox"/>
Fabrication Drawings	<input type="checkbox"/>
Samples (Where Applicable)	<input type="checkbox"/>

Proposed Product/Fabrication Method
(List trade name/description; model no.; manufacturer) : _____

Required Information for <i>Proposed</i> Product:	Attached:
Point by Point Comparative Product Data	<input type="checkbox"/> (Required)
Tests	<input type="checkbox"/>
Reports	<input type="checkbox"/>
Fabrication Drawings	<input type="checkbox"/>
Samples (Where Applicable)	<input type="checkbox"/>

List of Related Changes/Modifications: _____

Differences between proposed substitution
and specified product: _____

Proposed product/fabrication
method
affects other parts of the Work No Yes: Explain _____

Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product as utilized for this project, except as noted herein.
- Qualifications of manufacturer, installer, and other specified parties meet the specified qualifications.
- Same special warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source for replacement parts, as applicable, is available as that specified.
- Proposed substitution does not affect dimensions and functional clearances, except as noted herein.
- Proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
- Failure of proposed substitution to produce indicated results will not be considered grounds for additional payment or time.

For the Contractor:

Submitted by: _____
Signed: _____
Firm: _____
Telephone: _____
Fax: _____
Email: _____

For the Manufacturer:

Submitted by: _____
Signed: _____
Firm: _____
Telephone: _____
Fax: _____
Email: _____

END OF CONTRACTOR'S REQUEST FOR SUBSTITUTION FORM

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Construction Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Construction Manager are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.5 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.

- e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 6. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- C. Application for Payment Forms: Use AIA Document G703 and AIA Document G732 as form for Applications for Payment.
 1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.

2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Sustainable design action plans, including preliminary project materials cost data.
 7. Schedule of unit prices.
 8. Submittal schedule (preliminary if not final).
 9. List of Contractor's staff assignments.
 10. List of Contractor's principal consultants.
 11. Copies of building permits.
 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 13. Initial progress report.
 14. Report of preconstruction conference.
 15. Certificates of insurance and insurance policies.
 16. Performance and payment bonds.
 17. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. AIA Document G707.
 8. Evidence that claims have been settled.
 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 10. Final liquidated damages settlement statement.
 11. Proof that taxes, fees, and similar obligations are paid.

12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
1. General coordination procedures.
 2. Coordination drawings.
 3. RFIs.
 4. Digital project management procedures.
 5. Web-based Project management software package.
 6. Project meetings.

1.2 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities, list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location inbuilt facility. Keep list current at all times.

1.3 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such

conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

- B. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format:
 - a. Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using PDF format.
 3. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.

1.5 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Owner name.
 3. Owner's Project number.
 4. Name of Architect.
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.

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15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
 - C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 1. Attachments shall be electronic files in PDF format.
 - D. Architect's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect or Construction Manager of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
 - E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project management software.
 1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's contract drawings will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
- B. Web-Based Project Management Software Package: Use Architect's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project management software includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
 2. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.

3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 5 days after execution of the Agreement.
 1. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Preparation of Record Documents.
 - o. Use of the premises and existing building.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.

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- y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at regular intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of Proposal Requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
1. Startup construction schedule.
 2. Contractor's Construction Schedule.
 3. Construction schedule updating reports.
 4. Daily construction reports.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 2. Predecessor Activity: An activity that precedes another activity in the network.
 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
1. PDF file.
- B. Startup construction schedule.
1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at weekly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
 - 2. Contractor shall conduct operations in order to meet completion date as indicated in Agreement.
- B. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 30 days, unless specifically allowed by Architect.
 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 5. Startup and Testing Time: Include no fewer than 14 days for startup and testing.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than the amount of days indicated in Agreement for completion of punch list items and Final Completion.
- C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- D. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Final Completion percentage for each activity.
- E. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- F. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.6 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
 1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Punch list and Final Completion.
 - k. Activities occurring following Final Completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.

3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in the Contract Time.

1.7 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events.

10. Stoppages, delays, shortages, and losses.
11. Emergency procedures.
12. Orders and requests of authorities having jurisdiction.
13. Change Orders received and implemented.
14. Construction Change Directives received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Partial completions and occupancies.
18. Substantial Completions authorized.

- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013300 - ELECTRONIC SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Electronic Files Transfer: All submittals which contain electronic files shall be submitted through the Architects Newforma web site. The address and or link will be provided at or before the initial preconstruction conference. The Architect assumes no responsibility for information lost or not received by Contractors failure to submit through the Newforma web site.
1. Due to restrictions on size of documents that can be received through e-mail the use of the Newforma site is required. Failure to comply shall be at the contractors own risk and transmissions lost or not received will not apply or be considered in any delay claim associated with lost/missing or missed information.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's and Construction Manager's final release or approval.
 - g. Scheduled date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. General: Comply with requirements for Project Information Management System as specified in Section 013100 "Project management and Coordination" for submittals of Project Shop Drawings, Product Data, Samples, and other submittals, and for conditions for using Architect's digital data files.
- B. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 1. Upon request, Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD translated from REVIT file.
 2. The digital files are available under the following conditions:
 - a. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
 - b. Digital data drawings are not to be considered Contract Documents as defined by the General Conditions of the Contract for Construction.
 - c. The Contract Documents executed or identified in the Owner/Contractor Agreement, shall prevail in case of an inconsistency with subsequent versions made through manipulative electronic operations involving computers.
 - d. The Contractor shall not transfer or reuse Instruments of Service in electronic or machine-readable form without the prior written consent of the Architect.

3. Cost: Per sheet charges will be in accordance with Architect's rate as noted in the Digital Data Letter of Agreement. Charges may also apply for file format conversion.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Construction Manager.
 4. Transmittal Form for Electronic Submittals: Use software-generated form from Architect's Project Information Management System.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect and Construction Manager on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's and Construction Manager's action stamp.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for Project.
 - a. Architect , through Construction Manager, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. Submit Product Data before or concurrent with Samples.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: To the maximum extent possible, consistent with requirements for scale, submit Shop Drawings on sheets 8 1/2 by 11 inches or 11 by 17 inches. Retain subparagraph below unless default submittal format specified elsewhere in this article applies.
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.

- c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Architect and Construction Manager will retain one Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit product schedule in the following format:
 - a. PDF electronic file.
- F. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

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- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
 2. Date of evaluation.
 3. Time period when report is in effect.
 4. Product and manufacturers' names.
 5. Description of product.
 6. Test procedures and results.

7. Limitations of use.

- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM File Incorporation: Construction Manager will incorporate delegated-design drawings and data files into Building Information Model established for Project.
 - 1. Prepare delegate-design drawings in the digital data software program, version, and operating system indicated in Digital Data Letter of Agreement.
 - 2. Refer to Section 013100 "Project Management and Coordination" for requirements for coordination drawings.

PART 3 - EXECUTION**3.1 CONTRACTOR'S REVIEW**

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S AND CONSTRUCTION MANAGER'S ACTION

- A. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
 - 1. Architect's Review:
 - a. No exceptions taken.
 - b. Note markings.
 - c. Rejected.
 - d. Comments attached.
 - 2. Response Required of Contractor:
 - a. Confirm.
 - b. Resubmit.
- B. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

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DIGITAL DATA LETTER OF AGREEMENT

An Agreement between LS3P ASSOCIATES LTD. (the "Architect") and ___ (the "Licensee," either Original or Third Party, as the case may be) for Licensing of Digital Data

Architect: LS3P ASSOCIATES LTD.
434 Fayetteville St., Suite 1700
Raleigh, NC 27601
Contact: Dan Harrop, AIA

Licensee:
Original ___
3rd Party ___

Project No.: 8403-225630
Project Name: Cape Fear Harnett Cancer Center (Fit Up)
Location: Lillington, NC 27546
Date: _____

The Architect will provide the following Digital Data, dated as of the particular transmission, to the Licensee **for information purposes only:**

Sheet XXX (.dwg format)
Sheet XXX (.dwg format)
Sheet XXX (.dwg format)
Sheet XXX (.dwg format)

Revit MODEL (Revit 20XX)

Digital Data was prepared using the following:

Software: Revit (.rvt) **Version:**

Digital Data to be delivered via the following media: Newforma Website posting

Licensee shall pay the Architect a service fee of \$0.00 and other good and valuable consideration.

TERMS AND CONDITIONS

1. The Architect and its consultants make no representation as to the compatibility of the Digital Data with any hardware or software. The Licensee shall notify the Architect within five (5) business days of any problems associated with accessing and/or using the Digital Data.
2. The Licensee acknowledges and agrees that the Digital Data may change or degrade during the transmission process. The Licensee acknowledges and agrees that the Architect and its consultants may remove all indications of ownership from the Digital Data prior to transmission.
3. All Digital Data shall be considered the property of the Architect and/or its consultants and shall not be used for other Projects, for additions to this Project without the prior written permission of the Architect and/or its consultants. Digital Data shall not be re-transmitted by the Original Licensee to a Third-Party Licensee without prior execution of an agreement identical to this Agreement between the Architect, the Original Licensee, and the Third-Party Licensee. Under no circumstances shall the transmission of the Digital Data be considered a sale of goods or a sale of copyrights.

4. **THE ARCHITECT AND THE ARCHITECT'S CONSULTANTS HEREBY EXPRESSLY DISCLAIM ANY AND ALL WARRANTIES, BOTH EXPRESS AND IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AS WELL AS ANY WARRANTY OF ACCURACY, COMPLETENESS, AND/OR PERMANENCE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.** Addenda information and/or revisions made to the most current Digital Data after any date of transmission have not been incorporated into the transmitted Digital Data. In the event of a conflict between the Architect's printed instruments of service (2D Documents) whether sealed or unsealed) and the Digital Data (3D Model), the printed instruments of service shall govern. The Licensee acknowledges and agrees that the duty to determine the existence of any and all conflicts between the Digital Data and any other information upon which the Licensee relies rests solely upon the Licensee. The Digital Data shall not be considered Contract Documents or Construction Documents as defined by any General Conditions of Contract for Construction. The Digital Data is being provided for information only and on a strictly "AS IS" basis.

5. Licensee agree the extent of its reliance on any Digital Data shall be limited to the uses identified in this Agreement.

6. Licensee may use and rely upon the Digital Data only for programming, site analysis, design review, 3D coordination of structural, mechanical, plumbing, and electrical systems, and preconstruction activities.

7. The Level of Development (LOD) describes the minimum dimensional, spatial, quantitative, qualitative, and other data included in the Digital Data to support the uses and reliance included in this Agreement. The LOD of the Digital Data transmitted is LOD 200. LOD 200 is defined as model and model elements that are generically and graphically represented within the Digital Data with approximate quantity of major components, size, shape, location, and orientation.

8. If Licensee discovers or becomes aware of any discrepancies, inconsistencies, errors, or omissions in any Digital Data transmitted, they shall promptly report the discrepancy, inconsistency, error, or omission in writing to the Architect. Licensee shall not use any discrepancy, inconsistency, error, or omission in the Digital Data as the basis of a claim.

9. Any reliance on the Digital Data not in accordance with this Agreement shall be at the sole risk of the Licensee.

10. The use and/or provision of the Digital Data prepared by the Architect and/or its consultants shall not in any way reduce or obviate the Licensee's duty to check and coordinate dimensions, details, and quantities of materials as required to facilitate construction of the Project in a complete and quality manner consistent with the applicable standards of care. Confirmation of existing conditions is the sole responsibility of the Licensee.

11. The Licensee agrees to the extent permitted by applicable law, to indemnify, hold harmless, and release the Architect and/or its consultants, their officers, shareholders, employees, and sub-consultants from any and all injuries, claims, demands, expenses, suits, liabilities, losses, damages, costs, disputes, other matters in question, third party claims, pass-through claims, subrogated claims, and/or claim expenses related to the Digital Data, including but not limited to, attorneys' fees, expert witness fees, and court costs arising out of or in any way related to or connected with any negligent act and/or omission in the generation, provision, and/or use of the Digital Data by the Licensee and/or any of its subcontractors, suppliers, and/or consultants and waive any and all rights to such claims and causes of action.

12. The Licensee waives damages against the Architect for any and all injuries, claims, losses, expenses, damages, disputes, other matters in question, and/or claim expenses arising out of or relating to this Agreement and/or

generation, provision, and/or use of the Digital Data, including, but not limited to, consequential damages and reasonable attorneys' fees and defense costs.

13. The Architect's and/or the Architect's consultants' liability to the Licensee and/or any of its subcontractors, suppliers, and/or consultants for any and all injuries, claims, losses, expenses, damages, disputes, other matters in question, third party claims, pass-through claims, subrogated claims, and/or claim expenses arising out of or relating to this Agreement and/or the Digital Data, including, but not limited to, reasonable attorneys' fees and defense costs, regardless of the nature of the claim or damage, shall not exceed, either individually or in the aggregate, the total amount of \$1,000.00. Such causes include, but are not limited to, the Architect's and/or the Architect's consultants' negligence, errors, omissions, strict liability, breach of contract, and/or breach of warranty.

14. To the best of the Architect's knowledge, information and belief, there are no licensing or copyright fees due to others based on the transmission of the Digital Data, but to the extent that such unknown fees do exist, the Licensee agrees to pay the required fees and hold the Architect and/or its consultants harmless from any associated costs or penalties.

15. Upon execution of this Agreement, the Architect grants to the Licensee a non-exclusive, non-transferable (except as set forth herein), limited license to use the Digital Data solely and exclusively for informational purposes on the identified Project only, provided that the Licensee substantially performs its obligations under this Agreement.

16. Any purchase order number provided by the Licensee is for the Licensee's accounting purposes only. The Licensee acknowledges and agrees that purchase order terms and conditions are null, void, and inapplicable to this Agreement.

17. This Agreement constitutes the entire agreement between the parties relative to the Digital Data and shall be governed by the laws of the State of **North Carolina** without regard to principles of conflicts of law.

AUTHORIZED ACCEPTANCE

by Architect:
LS3P ASSOCIATES LTD.

by Original Licensee:

Signature

Signature

Print Name and Title

Print Name and Title

Date

Date

by Third Party Licensee:

Signature

Print Name and Title

Date

WE SO CONSENT:

by Owner:

Signature

Print Name and Title

Date

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Requirements:
 - 1. Section 014339 "Mockups" for additional requirements for mockups.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

- E. **Product Tests:** Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. **Source Quality-Control Tests and Inspections:** Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- G. **Testing Agency:** An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- H. **Quality-Assurance Services:** Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- I. **Quality-Control Services:** Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

1.3 DELEGATED DESIGN SERVICES

- A. **Performance and Design Criteria:** Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. **Delegated Design Services Statement:** Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

- A. **Conflicting Standards and Other Requirements:** If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as

appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

1.6 INFORMATIONAL SUBMITTALS

- A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- C. Reports: Prepare and submit certified written reports and documents as specified.
- D. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement of whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. **Installer Qualifications:** A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. **Specialists:** Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. **Testing and Inspecting Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. **Manufacturer's Technical Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. **Preconstruction Testing:** Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
1. Provide test specimens representative of proposed products and construction.
 2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
 5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
 6. **Testing Agency Responsibilities:** Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Testing Agency Responsibilities: Cooperate with Architect, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

- E. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- F. **Contractor's Associated Requirements and Services:** Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment at Project site.
- G. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. **Schedule of Tests and Inspections:** Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. **Schedule Contents:** Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
 2. **Distribution:** Distribute schedule to Owner, Architect, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. **Special Tests and Inspections:** Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect, Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.

3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- J. "Addenda": Written and/or graphic instruments issued by Architect prior to execution of Contract that modify or interpret Bidding Documents by additions, deletions, clarifications, or corrections. Addenda become part of Contract Documents when Construction Contract is executed.
- K. "By Owner (BO)": Items that will be ordered, paid for, and shipped to Project by Owner. Contractor shall receive, unload, unpack or uncrate, protect, move into place, install, and connect these items as specified or indicated in Contract Documents.
- L. "Herein": Contents of a particular Specification Section, or contents within any or all of parts and sections of Conditions of the Contract (General and Supplementary Conditions) and Division 01 - General Requirements.
- M. "Installer": Contractor or another entity engaged by Contractor, either as an employee, Subcontractor, or contractor of lower tier, to perform a particular construction activity,

including installation, erection, application, and similar operations. Installers are required to be experienced in operations in which they are engaged to perform.

- N. "Not in Contract (NIC)": Products not in Contract, but which may require provisions in construction for future installation by others.
- O. "Testing Agencies": Independent entity engaged to perform specific inspections or tests, either at Project site or elsewhere, or to report on and, if required, to interpret results of those inspections or tests.
- P. "Trades": Using terms such as carpentry is not intended to imply that accredited or unionized individuals of corresponding generic name, such as carpenter, must perform certain construction activities. It also does not imply that requirements specified apply exclusively to tradespeople of corresponding generic name.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
 - 1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 - 2. ICC - International Code Council; www.iccsafe.org.
 - 3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

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SECTION 014339 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Room mockups.

1.2 DEFINITIONS

- A. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting as indicated.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Construction Manager, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in room mockups.
 - 2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
 - 3. Review locations and extent of mockups.
 - 4. Review testing procedures to be performed on mockups.
 - 5. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and maintain schedule for the Work.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For room mockups.
- B. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Room Mockup Coordination Drawings: Floor Plans, Interior Elevations, drawn to scale and coordinated with each other, using input from installers of the items involved:
 - 1. Architecturally significant equipment.
 - 2. In-wall/ceiling rough-in locations.
 - 3. Other items necessary for coordination.

1.6 QUALITY ASSURANCE

A. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.
5. Perform preconstruction testing, such as window air- and water-leakage testing.

B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect or Construction Manager.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

C. Notifications:

1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
2. Notify Architect 14 days in advance of the dates and times when mockups will be tested.
3. Allow seven days for initial review and each re-review of each mockup.

D. Approval: Obtain Architect's and Construction Manager's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design support structure for free-standing mockups.
- B. Mockup Testing Performance Requirements: Perform tests using design pressures and performance criteria indicated for assemblies and products that are specified in other Sections and incorporated into mockups.

2.2 ROOM MOCKUPS

- A. Build room mockups according to approved mockup Shop Drawings to evaluate constructability, demonstrate the coordination of trades and sequencing of Work, and to demonstrate aesthetic requirements. Include each visible finish, component, and equipment item within room mockups; include operable lighting.
- B. Provide room mockups of the following rooms:
 - 1. Classroom.
 - 2. Patient care room.
- C. The Work of room mockups includes, but is not limited to, the following:
 - 1. Millwork and casework.
 - 2. Doors and frames.
 - 3. Access doors and frames.
 - 4. Metal framing.
 - 5. Gypsum board.
 - 6. Ceramic tiling.
 - 7. Acoustical ceilings.
 - 8. Resilient flooring.
 - 9. Painting.
 - 10. Registers and grilles.
 - 11. Wiring devices.
 - 12. Lighting.

PART 3 - EXECUTION

END OF SECTION 014339

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

2.2 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.

2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
 3. Drinking water and private toilet.
 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead unless otherwise indicated.
 - 2. Connect temporary service to Owner's existing power source, as directed by Owner.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install Wi-Fi cell phone access equipment land-based telephone line(s) for each field office.
 - 1. Post a list of important telephone numbers.
 - a. Police and fire departments.

- b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
- I. Electronic Communication Service: Provide secure Wi-Fi wireless connection to internet with provisions for access by Architect and Owner.
- J. Project Computer: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
- 1. Operating System: Microsoft Windows 10 Professional.
 - 2. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
 - 3. Backup: External hard drive, minimum 2 terrabytes, with automated backup software providing daily backups.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
- 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
 - 2. Utilize designated area within existing building for temporary field offices.
 - 3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
- 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Provide temporary offsite parking areas for construction personnel.
- D. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
- 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.

- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touch up signs, so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Elevator Use:.
- J. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
1. Do not load elevators beyond their rated weight capacity.
 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- C. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

- D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.

6. Discard and replace stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the

specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Electronic Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
 - 2. Store products to allow for inspection and measurement of quantity or counting of units.

3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.5 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect through Construction Manager in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

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5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions of Section 012500 "Substitution Procedures" are satisfied. If the conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements.

- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Electronic Submittal Procedures."
1. Form of Approval of Submittal: As specified in Section 013300 "Electronic Submittal Procedures."
 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.

1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Membranes and flashings.
 - b. Sprayed fire-resistive material.
 - c. Equipment supports.
 - d. Piping, ductwork, vessels, and equipment.
 - e. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect through Construction Manager in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb, and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

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SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for the following:
 - 1. Recycling nonhazardous construction waste.
 - 2. Disposing of nonhazardous construction waste.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Disposal: Removal off-site of construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- C. Recycle: Recovery of construction waste for subsequent processing in preparation for reuse.

1.3 PERFORMANCE REQUIREMENTS

- A. Contractor is encouraged to recycle as much nonhazardous construction waste as practical, without incurring additional costs to the Owner.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****3.1 WASTE MANAGEMENT AND DISPOSAL, GENERAL**

- A. General: Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Review requirements established for recycling and disposal.
- C. 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 recycled, reused, donated, and sold.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING CONSTRUCTION WASTE

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- 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 according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until 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 from Owner's property and transport to recycling receiver or processor.

3.3 DISPOSAL OF WASTE

- A. General: Except for items or materials to be 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 accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Final cleaning.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 5. Submit testing, adjusting, and balancing records.
 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
 5. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect and Construction Manager.
 - d. Name of Contractor.
 - e. Page number.

4. Submit list of incomplete items in the following format:
 - a. PDF Electronic File: Architect, through Construction Manager, will return annotated file.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.
 - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

- k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - l. Remove labels that are not permanent.
 - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - r. Clean strainers.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
1. Operation and maintenance documentation directory manuals.
 2. Emergency manuals.
 3. Systems and equipment operation manuals.
 4. Systems and equipment maintenance manuals.
 5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
1. PDF Electronic File: Assemble each operation and maintenance manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 9. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 - 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 - 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 - 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.6 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

1.7 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

1.8 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
1. Record Drawings.
 2. Record specifications.

1.2 CLOSEOUT SUBMITTALS

- A. General: Comply with requirements for Project Information Management System as specified in Section 013100 "Project Management and Coordination" for submittals of Project record documents and use of Architect's digital data files.
- B. Record Drawings: Comply with the following:
1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit annotated PDF electronic files of scanned record prints or record digital data files.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit annotated PDF electronic files of scanned Record Prints or digital data files
 - 2) Submit each drawing file, whether or not changes and additional information were recorded.
- C. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data,

whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
2. Content: Types of items requiring marking include, but are not limited to, the following:
- a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
 4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.

- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect and Construction Manager.
 - e. Name of Contractor.

1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
- B. Format: Submit record specifications as annotated PDF electronic file.

1.5 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.2 CLOSEOUT SUBMITTALS

- A. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.3 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.4 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.5 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017900

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Shelf angles.
3. Television mounting brackets.
4. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- B. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated to design ladders.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Stainless-Steel Bars and Shapes: ASTM A276, Type 304 or Type 316.
- D. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- E. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- F. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- G. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- H. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.

2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches from ends and corners of units and 24 inches o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
 - 1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches o.c.
- D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

2.7 TELEVISION MOUNTING BRACKETS

- A. Bracket: Full-motion, locking tilt TV wall mount hook-and-hang system with scratch resistant finish.

1. Accommodates TV screen minimum size: 80-inch.
2. Load Capacity: up to 150 lbs.
3. Adjustable height, width, swivel, and extension.
4. Vesa Display Mounting Standard Compatible: Yes.

2.8 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.10 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.

2.11 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 1. Shop prime with universal shop primer.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION**3.1 INSTALLATION, GENERAL**

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 Install television mounting brackets where indicated on Drawings.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Wood blocking, cants, and nailers.
 2. Plywood backing panels.

1.2 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NHLA: National Hardwood Lumber Association.
 3. NLGA: National Lumber Grades Authority.
 4. SPIB: The Southern Pine Inspection Bureau.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Power-driven fasteners.
3. Powder-actuated fasteners.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

- D. Application: Treat items indicated on Drawings, and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Use treatment that does not promote corrosion of metal fasteners.
 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Application: Treat items indicated on Drawings, and the following:
1. Concealed blocking.
 2. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Nailers.
 3. Cants.
 4. Furring.
- B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber and any of the following species:
1. Mixed southern pine; SPIB.

2. Spruce-pine-fir; NLGA.
 3. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine, No. 3 grade; SPIB.
 2. Hem-fir or hem-fir (north), Standard or No. 3 Common grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or spruce-pine-fir, Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 4. Eastern softwoods, No. 3 Common grade; NELMA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Metal Framing: ASTM C1002, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in

unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.7 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.

- H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 123661.16 "Solid-Surfacing Countertops."

1.2 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 ACTION SUBMITTALS**A. Product Data:** For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
5. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples for Verification: For the following:

1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.

- a. Provide one sample applied to core material with specified edge material applied to one edge.
2. Thermally Fused Laminate (TFL) Panels: 8 by 10 inches, for each color, pattern, and surface finish.
 - a. Provide edge banding on one edge.
3. Corner Pieces:
 - a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.
4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Fabricator and Installer.
- B. Product Certificates: For each type of product.

1.5 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

- A. Fabricator's Qualifications: 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.
 1. Fabricator's Certification: Licensed participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Licensed participant in AWI's Quality Certification Program.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Build mockups of typical architectural cabinets as shown on Drawings.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation

areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.
- C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
- D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Architectural Woodwork Standards Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.

- E. High-Pressure Decorative Laminate (**PLM-1**): NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Wilsonart LLC ; High Pressure Laminate, or a comparable product by one of the following:
 - a. Formica Corporation.
 - b. Wilsonart LLC (Basis-of-Design).
 - c. Pionite Laminate.
 2. Products, Colors, and Patterns: As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.
- F. Laminate Cladding for Exposed Surfaces:
1. Horizontal Surfaces: Grade HPL.
 2. Vertical Surfaces: Grade HGS.
 3. Edges: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
 4. Pattern Direction: As indicated.
- G. Materials for Semi-exposed Surfaces:
1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
 - b. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
 - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
 2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.
 3. Drawer Bottoms: Thermally fused laminate panels.
- H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 8 to 13 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 - 2. Particleboard (Medium Density): ANSI A208.1, Grade M-2-Exterior Glue.
 - 3. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products in accordance with test method indicated by a qualified testing agency.
 - 1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
 - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less in accordance with ASTM E84.
 - 1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.
 - 2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi; modulus of elasticity, 250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.
- C. Fire-Retardant Fiberboard: MDF panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less in accordance with ASTM E84.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."
- B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening.
- C. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.
- D. Wire Pulls: Back mounted, solid metal.
- E. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.
- F. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
- G. Shelf Rests: ANSI/BHMA A156.9, B04013; two-pin plastic with shelf hold-down clip.
- H. Drawer Slides: ANSI/BHMA A156.9.
 - 1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
 - a. Type: Full extension.
 - b. Material: Epoxy-coated polymer slides.
 - 2. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
 - 3. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
 - 4. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
 - 5. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
- I. Door Locks: ANSI/BHMA A156.11, E07121.
- J. Drawer Locks: ANSI/BHMA A156.11, E07041.
- K. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
 - 1. Matte Black (Cast Iron): ANSI/BHMA 622 for steel base.
- M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
 - 2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
 - 1. Inspection entity shall prepare and submit report of inspection.

3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 064116

SECTION 066423 - SOLID POLYMER FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes solid polymer fabrications for interior applications.
 - 1. Solid polymer resin sheets.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details for solid polymer resin sheets. Include the following:
 - 1. Size and location of penetrations.
 - 2. Type of decorative fabrications.
 - 3. Paneling methods.
 - 4. Mounting methods.
 - 5. Attachments to other work.
 - 6. Full-size details of edge profiles.
- C. Samples for Verification: For the following products, in manufacturer's standard sizes:
 - 1. Solid polymer resin sheets.
 - 2. Hardware for mounting.
- D. Product Schedule: For solid polymer resin sheets. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Product Test Reports: For solid polymer resin sheets, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Sample Warranty: For manufacturer's warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid polymer resin sheets to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of solid polymer resin sheet through one source from a single manufacturer to provide products of consistent quality in appearance and physical properties.
- B. Fire-Test-Response Characteristics: Provide solid polymer resin sheets identical to those tested for the following fire-test-response characteristics:
 - 1. Flame Spread: Less than 75 per ASTM E84.
 - 2. Smoke Developed: Less than 450 per ASTM E84.
 - 3. Rate of Burning: Class CC1 for a nominal thickness of 1.5 mm (0.060 in.) per ASTM D635.
 - 4. Self-Ignition Temperature: Greater than 650°F per ASTM D1929.
 - 5. Density of Smoke: Less than 75% per ASTM D2843.
- C. Impact Resistance: Provide Solid Polymer Fabrications that comply with the following requirements:
 - 1. Impact Strength, Un-notched (23°), ASTM D4812: No breakage
 - 2. Impact Strength, Notched (23°), ASTM D526: 88J/m (1/16).
- D. Allowable Tolerances:
 - 1. Maximum Deflection: 1/16 inch over 12 inches.
- E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup in locations and in sizes as directed by Architect.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for shipping, storing, and handling solid polymer resin sheets and for removing protective coverings after installation.
- B. Maintain protective coverings on sheets to avoid exposures to abrasive substances, excessive heat, and other sources of possible deterioration.
- C. Move solid polymer resin sheet material into spaces where they are to be installed and allow it to reach room temperature prior to installation.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with installing paneling sealants when ambient and substrate temperature conditions are outside limits permitted by paneling sealant manufacturers or below 40 deg F.
- B. Field Measurements: Verify dimensions to fit by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace solid polymer resin sheets that develop defects from normal use within specified warranty period.
 - 1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Solid Polymer Resin Sheets (**RP-1**), (**RP-2**):
 - 1. Subject to compliance with requirements, provide the following:
 - 2. 3form; Varia.
 - a. Color and Pattern: As indicated in the Arch-Material Finishes (Interior) schedule on the Drawings.
- B. Thickness: As indicated on the Drawings.
- C. Colors:
 - 1. RP-1: Strum Gemini.
 - 2. RP-2: Strum Flip.
- D. Finish: Honed.

2.2 SOLID POLYMER RESIN SHEET

- A. General: Fabricate solid polymer resin sheet for decorative paneling in designs, sizes and thicknesses indicated and to comply with indicated standards.
- B. Fabricate decorative paneling and provide other paneling products in sizes required for openings and surfaces indicated on Drawings, with edge and face clearances, edge and surface conditions complying with manufacturer's written recommendations.

- C. Machining: Acceptable means of machining are indicated below. Ensure that material is not chipped or warped by machining operations.
1. Sawing: Select equipment and blades suitable for type of cut required.
 2. Drilling: Drills specifically designed for use with solid polymer resin sheet products.
 3. Milling: Clean cut where possible.
 4. Routing.
 5. Tapping.
- D. Forming: Form products to shapes indicated using appropriate methods indicated below. Comply with manufacturer's written instructions.
1. Cold-bending.
 2. Hot-bending.
 3. Thermoforming; only on uncoated material.
 4. Drape forming.
 5. Matched mold forming.
 6. Mechanical forming.

2.3 ACCESSORIES

- A. Cleaners: Comply with manufacturer's written recommendations.
- B. Bonding Cement: Suitable for use with product and application and complying with manufacturer's written recommendations.
- C. Hardware: Use hardware as recommended by manufacturer.

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

3.2 PREPARATION

3.3 INSTALLATION

- A. Comply with combined written instructions of manufacturers of solid polymer resin sheet materials, sealants, gaskets, and related materials, unless more stringent requirements are indicated.
- B. Install solid polymer resin sheets according to manufacturer's written instructions and approved Shop Drawings.

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- C. Protect solid polymer resin sheet surfaces from abrasion and other damage during handling and installation, according to the following requirements.
1. Retain solid polymer resin sheet manufacturer's protective covering or protect by other methods according to solid polymer resin sheet manufacturer's written instructions.
 2. Remove covering at border of each piece before installing; remove remainder of covering immediately after installation where solid polymer resin sheets will be exposed to sunlight or where other conditions make later removal difficult.
 3. Remove damaged solid polymer resin sheets from Project site and legally dispose of off-site. Damaged solid polymer resin sheets are those containing imperfections that, when installed, result in weakened paneling and impaired performance and appearance.
- D. Set solid polymer resin sheets true in line with uniform orientation, pattern, draw, bow, and similar characteristics.

3.4 PROTECTION AND CLEANING

- A. Protect solid polymer resin sheet fabrications from contact with contaminating substances from construction operations. If contaminating substances come into contact with solid polymer resin sheets, remove immediately and wash by method recommended in writing by solid polymer resin sheet manufacturer.
- B. Remove and replace solid polymer resin sheets that are broken, chipped, cracked, abraded, or damaged in other ways during construction period.
- C. Wash solid polymer resin sheets on both faces before date scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Wash solid polymer resin sheets by method recommended in writing by solid polymer resin sheet manufacturer.

END OF SECTION 066423

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SECTION 078413 - PENETRATION FIRESTOPPING**1.1 SUMMARY****A. Section Includes:**

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.

B. Related Sections:

1. Section 078446 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction and in smoke barriers.

1.2 ACTION SUBMITTALS**A. Product Data:** For each type of product indicated.**B. Shop Drawings:** For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.

C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS**A. Qualification Data:** For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.**B. Installer Certificates:** From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.4 QUALITY ASSURANCE

- A. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified firestop contractor.
- B. Source Limitations: Obtain through-penetration firestop systems from a single manufacturer.
- C. Installer Qualifications: An experienced installer who is qualified by having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Firm shall hold current certification by third party attesting to its ability to select and install firestopping in accordance with performance requirements, have established management system for firestopping and employ trained supervisor (DRI) to maintain oversight of firestopping installation.
1. Certification of Firestopping Firms: Firm shall have a minimum of 10 years experience in firestopping and be certified by the qualified manufacturers of firestop system materials listed in Part 2.
 2. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.
- D. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
1. Before installation of fire-resistance-rated assemblies and penetrating items, review through-penetration firestop system and examine procedures for ensuring quality of installed systems. Require representatives of each entity directly concerned with through-penetration firestop system to attend, including the following:

- a. Contractor's superintendent.
 - b. Independent testing agency responsible for through-penetration firestop system.
 - c. Through-penetration firestop system Manufacturer's service representative.
 - d. Through-penetration firestop system Installer.
 - e. Fire- resistance-rated masonry Installer.
 - f. Fire- resistance-rated gypsum board assembly Installer.
 - g. Mechanical piping Installer.
 - h. HVAC ductwork Installer.
 - i. Electrical wireway Installer.
2. Review inspection and testing and inspecting agency procedures for field quality control, through-penetration firestop system installation, and coordination of penetrating item configurations with available rated through-penetration firestop system assemblies.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hilti Construction Chemicals, Inc.
 2. Specified Technologies Inc.
 3. 3M Fire Protection Products.
 4. Tremco.

2.2 FIRESTOPPING, GENERAL

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
- D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.

2.3 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems in accordance with ASTM E 2174 and to prepare test reports.
 - 1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.
- B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.
- C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

- A. Identify through-penetration firestop systems with preprinted metal or plastic labels or pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - 1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Through-penetration firestop system designation of applicable testing agency.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

- B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 078413

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SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

This Section includes fire-resistive joint systems for the following:

1. Joints in or between fire-resistance-rated constructions.

Related Sections include the following:

2. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.2 ACTION SUBMITTALS

Product Data: For each type of product indicated.

Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

Shop Drawings: For each fire-resistive joint system, show relationships to adjoining construction. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

2. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

1.3 INFORMATIONAL SUBMITTALS

Qualification Data: For qualified Installer.

Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

Research/Evaluation Reports: For each type of fire-resistive joint system.

1.4 QUALITY ASSURANCE

Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified firestop contractor.

Source Limitations: Obtain fire-resistive joint systems through one source from a single manufacturer.

Contractor Qualifications: An experienced installer who is qualified by having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Firm shall hold current certification by third party attesting to its ability to select and install firestopping in accordance with performance requirements, have established management system for firestopping and employ trained supervisor (DRI) to maintain oversight of firestopping installation.

1. Certification for firestopping firms: Firm shall be certified by one of the following:
 - a. Factory Mutual Global: FM Standard 4991.
 - b. UL Qualified Firestop Contractor.
2. Qualification for Mechanics: Trained individual in accordance with requirements of certification of firm.
 - a. Firestop Installers Training (FIT) Level 1 by Specified Technologies, Inc.
 - b. Certified 3M Trained by 3M Fire Protection Products..
 - c. Similar training by manufacturers listed in Part 2.
3. A manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.

Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:

4. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
5. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
 - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."

Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS

Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.7 COORDINATION

Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

Coordinate sizing of joints to accommodate fire-resistive joint systems.

Notify Owner's inspecting agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on days preceding each series of installations.

Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Hilti Construction Chemicals, Inc.
2. Specified Technologies Inc.
3. 3M Fire Protection Products.
4. Tremco.

2.2 FIRE-RESISTIVE JOINT SYSTEMS, GENERAL

Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:

1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies .
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.

Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

PART 3 - EXECUTION

3.1 EXAMINATION

Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 IDENTIFICATION

Identify fire-resistive joint systems with preprinted metal or plastic labels or self-adhesive vinyl labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."

3.4 INSTALLATION

General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

2. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
3. Apply fill materials so they contact and adhere to substrates formed by joints.
4. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.5 FIELD QUALITY CONTROL

Inspecting Agency: Owner may engage a qualified independent inspecting agency to inspect fire-resistive joint systems and to prepare inspection reports.

1. Inspecting agency will state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and inspecting agency has approved installed fire-resistive joint systems.

If deficiencies are found, repair or replace fire-resistive joint systems so they comply with requirements.

3.6 CLEANING AND PROTECTION

Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078446

SECTION 079200 - JOINT SEALANTS

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. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical joint sealants.

- B. Related Sections:

1. Section 088000 "Glazing" for glazing sealants.
2. Section 092900 "Gypsum Board" for sealing perimeter joints.
3. Section 093000 "Tiling" for control joint sealants in ceramic tile installations.
4. Section 095113 "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.4 ACTION SUBMITTALS

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

1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- E. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and testing agency.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Field-Adhesion Test Reports: For each sealant application tested.
- F. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- E. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period for urethane sealants: 5 years from date of Substantial Completion.
 - 2. Verify available warranties and warranty periods with manufacturers listed in Part 2 articles.
 - 3. Warranty Period for silicone sealants: 20 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant **ES-2**: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 795.
 - b. GE Advanced Materials - Silicones; SilPruf NB SCS9000.
 - c. Pecora Corporation; 864.
 - d. Tremco Incorporated; Spectrem 3.
- B. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing or Acid Curing Silicone Joint Sealant **ES-4**: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; 898.
 - b. BASF Building Systems; Omniplus.
 - c. Dow Corning Corporation; 786 Mildew Resistant.
 - d. GE Advanced Materials - Silicones; Sanitary SCS1700.

- e. May National Associates, Inc.; Bondaflex Sil 100 WF.
- f. Tremco Incorporated; Tremsil 200 Sanitary.

- C. Textured, Field Tintable, Non-staining Neutral-curing Silicone Sealant **ES-4**:
 - 1. Basis of Design: Pecora 890FTS-TXTR

2.3 LATEX JOINT SEALANTS

- A. Latex Joint Sealant **LS-1**: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, provide one of the following :
 - a. BASF Building Systems; Sonolac.
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. Pecora Corporation; AC-20+.
 - d. Schnee-Morehead, Inc.; SM 8200.
 - e. Tremco Incorporated; Tremflex 834.

2.4 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints **AS-1**: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
- B. Acoustical Sealant for Concealed Joints **AS-2**: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
 - 1. Products:
 - a. Pecora Corporation; BA-98.
 - b. Tremco; Tremco Acoustical Sealant.
- C. Acoustical Fire Rated Outlet Backer Pad:
 - 1. Basis of Design: IsoBacker from Kinetics Noise Control.

2.5 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

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

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 INSTALLATION OF ACOUSTICAL SEALANTS

- A. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.
 1. Where partition seals to a rough, textured or corrugated surface, provide closure strips to ensure complete contact with surface.
- B. At sound-rated assemblies, wrap back and sides of outlet boxes with acoustical backer pads.

3.5 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.6 CLEANING

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

3.7 PROTECTION

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

3.8 INTERIOR JOINT SEALANT SCHEDULE

- A. Vertical control and expansion joints on exposed interior surfaces of exterior walls.
 1. ES-2 Single-component neutral-curing silicone sealant.
- B. Interior perimeter joints of exterior openings.
 1. ES-2 Single-component neutral-curing silicone sealant.
- C. Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
 1. ES-4 Single-component mildew-resistant neutral -curing silicone sealant.
- D. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
 1. LS-1 Latex sealant.
 2. Joint-Sealant Color: Paintable white.
- E. Other non-dynamic interior joints including between interior wall surfaces and casework.
 1. LS-1 Latex sealant.
 2. Joint-Sealant Color: Clear.
- F. Acoustical interior joints for exposed joints.
 1. AS-1 Latex sealant.
- G. Acoustical interior joints for concealed joints.

1. AS-2 Latex sealant.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

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 hollow-metal work.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation 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.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 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. 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 final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amweld International, LLC.
 2. Ceco Door Products; an Assa Abloy Group company.
 3. Curries Company; an Assa Abloy Group company.
 4. Custom Metal Products.
 5. D & D Specialties, Inc. Union, SC.
 6. Deansteel.
 7. Fleming-Baron Door Products.
 8. Greensteel Industries, Ltd.
 9. Karpen Steel Custom Doors & Frames.
 10. L.I.F. Industries, Inc.
 11. Mesker Door Inc.
 12. Pioneer Industries, Inc.

13. Republic Doors and Frames.
 14. Steelcraft; an Ingersoll-Rand company.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Labels: Provide permanent labels of aluminum, stainless steel or other non-corrosive material.
- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR FRAMES

- A. Construct interior frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra Heavy-Duty Frames: SDI A250.8, Level 3.
1. Physical Performance: Level A according to SDI A250.4.
 2. Frames:
 - a. Materials: Metallic-coated, steel sheet, minimum thickness of 0.052 inch.
 - b. Construction: Welded.
 3. Exposed Finish: Prime.

2.4 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, mechanically attached to back of frames; not less than 0.042 inch thick.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, 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, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z 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. Power-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, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Section 088000 "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 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 metal thickness. 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. 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. 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.

2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, 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 one 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 one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, 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.

C. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.8 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

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. 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. Drill and tap frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- 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 SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 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-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 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 plumb, square, 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 will be filled with grout.

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 power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. 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.

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 Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

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SECTION 081216 - ALUMINUM FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior aluminum doors, door frames, and glazing frames.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum frames:

1. Include elevations, sections, and installation details for each wall-opening condition.
2. Include details for each frame type, including dimensioned profiles and metal thicknesses.
3. Include locations of reinforcements and preparations for hardware.
4. Include details of anchorages, joints, field splices, connections, and accessories.
5. Include details of moldings, removable stops, and glazing.

C. Samples for Verification: For each type of the following products:

1. Framing Member and Finish: 12 inches long. Include trim.
2. Corner Fabrication and Finish: 12-by-12-inch- long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.
3. Door Finish: Manufacturer's standard-size unit, but not less than 3 inches square.

- D. Product Schedule: For aluminum frames. Use same designations indicated on Drawings. Coordinate with door hardware schedule and glazing.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum frames to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of each type of aluminum frame and door in typical wall area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Aluminum Products.
 - 2. Avanti Systems.
 - 3. Frameworks Manufacturing.
 - 4. Raco Interior Products (Basis-of-Design).
 - 5. Wilson Partitions.
- B. Source Limitations: Obtain aluminum frames and frame-manufacturer's doors from single source from single manufacturer.

2.2 INTERIOR ALUMINUM DOORS, DOOR FRAMES, AND GLAZING FRAMES

- A. Aluminum Framing: ASTM B221, with alloy and temper required to suit structural and finish requirements, and not less than 0.062 inch thick.
- B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.
- C. Glazing Frames: Extruded aluminum, for indicated glass thickness.
- D. Trim: Extruded aluminum, not less than 0.062 inch thick; removable, snap-in casing trim glazing stops and door stops, without exposed fasteners.
- E. Doors:
 - 1. Manufacturer's standard, factory-assembled, 1-3/4-inch- thick, aluminum-framed door construction.
 - a. Door Operation: Swinging.
 - b. Stiles: Narrow.

- c. Rails: Manufacturer's slim profile top rail and manufacturer's slim profile bottom rail.
- F. Door Finish: Match frame and trim finish.
 - 1. Color: As selected by Architect from manufacturer's full range.
- G. Frame and Trim Finish: Factory-applied, baked-enamel or powder-coat finish.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

- A. Fasteners: Aluminum, nonmagnetic, stainless steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.
- B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals in black color.
- C. Glazing Gaskets: Manufacturer's standard extruded or molded rubber or plastic, to accommodate glazing thickness indicated; in black.
- D. Glass: As specified in Section 088000 "Glazing."
- E. Door Hardware: As selected by Architect from manufacturer's full range.

2.4 FABRICATION

- A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted and mitered connections.
- B. Fabricate frames for glazing with removable stops to allow glazing replacement without dismantling frame.
 - 1. Locate removable stops on the inside of spaces accessed by keyed doors.
- C. Fabricate components to allow secure installation without exposed fasteners.

2.5 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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. Verify that wall thickness does not exceed standard tolerances allowed by throat size of indicated aluminum frame.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install aluminum frames plumb, rigid, properly aligned, and securely fastened in place; according to manufacturer's written instructions.
- B. Install frame components in the longest possible lengths with no piece less than 48 inches; components 96 inches or shorter shall be one piece.
 - 1. Fasten to suspended ceiling grid on maximum 48-inch centers, using sheet metal screws or other fasteners approved by frame manufacturer.
 - 2. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
 - 3. Secure clips to extruded main-frame components and not to snap-in or trim members.
 - 4. Do not leave screws or other fasteners exposed to view when installation is complete.
- C. Glass: Install glass according to Section 088113 "Decorative Glass Glazing" and aluminum-frame manufacturer's written instructions.
- D. Doors: Install doors aligned with frames and fitted with required hardware.
- E. Door Hardware: Install according to aluminum-frame manufacturer's written instructions.

3.3 ADJUSTING

- A. Inspect installation, correct misalignments, and tighten loose connections.
- B. Doors: Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly, and lubricate as recommended by manufacturer.

- C. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended in writing by frame manufacturer and according to AAMA 609 & 610.
- D. Touch Up: Repair marred frame surfaces to blend inconspicuously with adjacent unrepaired surface so touchup is not visible from a distance of 48 inches as viewed by Architect. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 081216

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SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), 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 finished Work.
2. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

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

1.7 WARRANTY

- A. Special Warranty: 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 face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design:: Subject to compliance with requirements, provide products by the Basis-of-Design indicated by the following:
 - 1. Masonite Architectural Doors: Aspiro™ Series

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

1. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
- B. Fire-Rated Wood Doors: Doors 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 NFPA 252.
1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 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.
- C. Structural-Composite-Lumber-Core Doors:
1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.
- D. Mineral-Core Doors:
1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - a. Screw-Holding Capability: 475 lbf per WDMA T.M.-10.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors (**FWD-1**):

1. Grade: Custom (Grade A faces).
2. Species: White Birch.
3. Cut: Rotary cut.
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.

8. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
9. Exposed Vertical and Top Edges: Same species as faces - edge Type A.
10. Core: Structural composite lumber.
11. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.

2.4 ACCESSORIES

- A. Coat Hooks: As indicated in Hardware Schedule.

2.5 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
 1. Wood Species: Same species as door faces.
 2. Profile: Manufacturer's standard shape.
 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.6 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 NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Provide door hardware as shown on Drawings and specified in Division 08 "Door Hardware".
- C. Openings: Factory cut and trim openings through doors.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.7 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 bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 13, catalyzed polyurethane.
 - 3. Stain Color: Caramel.
 - 4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed 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.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
 - 2. Install smoke- and draft-control doors according to NFPA 105.
- 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.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or 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 081416

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Interior storefront framing.
2. Interior manual-swing entrance doors and door-frame units.

B. Related Sections:

1. Section 087100 "Door Hardware" for entrance system hardware to the extent not specified in this Section.

1.2 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.

B. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to $3/4$ inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces

edge clearance between framing members and glazing or other fixed components directly below them to less than 1/8 inch and clearance between members and operable units directly below them to less than 1/16 inch.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations. Reference Division 08 Hardware Schedule.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
- F. Other Submittals:
 - 1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- G. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of aluminum-framed systems.
 - 2. Include design calculations.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Welding certificates.

- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.
- D. Field quality-control reports.
- E. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain aluminum-framed entrance and storefronts and glazed aluminum curtain wall through one source from a single manufacturer.
- B. Manufacturer's Qualifications: Provide entrances and storefront produced by a single manufacturer with not less than 10 years successful experience in the fabrication of assemblies of the type and quality required.
- C. Installer Qualifications: Entrances and storefront shall be installed by a firm that has not less than 5 years successful experience in the installation of systems similar to those required.
- D. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated.
- E. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- F. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- G. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- H. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

- I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to aluminum-framed entrances and storefront including, but not limited to, the following:
 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. Review and discuss the finishing of aluminum storefront that is required to be coordinated with the finishing of other aluminum for color and finish matching.
 3. Review, discuss, and coordinate the interrelationship of aluminum storefront with other wall components. Include provisions for structural anchorage, glazing, flashing, weeping, sealants, and protection of finishes.
 4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

- J. Installation Conference: Demonstrate installation method for aluminum storefront systems.
 1. Notify Architect and Owner's representative seven days in advance of dates and times when in-place mockups will be constructed.
 2. Set unit in opening, glaze and seal.
 3. Obtain Architect's approval of mockups before continuing installation of aluminum-framed entrances and storefront.
 4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water leakage through fixed glazing and framing areas.
 - e. Failure of operating components.
 2. Warranty Period: Five years from date of Substantial Completion.

- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in

materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.

1.10 MAINTENANCE

A. Entrance Door Hardware:

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide basis of design or comparable product by one of the following:

1. EFCO Corporation.
2. Kawneer North America; an Alcoa company.
3. Tubelite.
4. United States Aluminum.
5. Oldcastle Building Envelope
6. YKK AP America Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
3. Extruded Structural Pipe and Tubes: ASTM B429.
4. Structural Profiles: ASTM B308/B308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Glazing System: Retained mechanically with gaskets on four sides.
 - 2. Glazing Plane: Center.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Perimeter Filler: Provide perimeter filler / backer plate to close back of frame and facilitate placement of backer rod and sealant.
 - 1. Back Plates: Furnish jamb and head framing members with manufacturer's standard continuous back plates, unless continuous plates are integral to the design of the framing system.
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A123/A123M or ASTM A153/A153M.
- F. Concealed Flashing: Dead-soft, 0.018-inch- thick stainless steel, ASTM A240/A240M of type recommended by manufacturer.
- G. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's Heavy Duty glazed entrance doors for manual-swing operation.
1. Door Construction: 2-inch overall thickness, with minimum 0.188-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 2. Door Design: Wide stile; 5-inch nominal width.
 - a. Bottom Rail: 10-inch height to meet ADA requirements.
 - b. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
 4. Weather Stripping: Manufacturer's standard replaceable components.
 - a. Compression Type: Made of ASTM D2000, molded neoprene, or ASTM D2287, molded PVC.
 - b. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
 5. Finish: Clear anodic.
 6. Entrance Door Hardware: Provide manufacturer's standard aluminum door hardware.

2.6 INTERIOR DOOR SYSTEMS

- A. Interior Doors: Manufacturer's Heavy Duty glazed entrance doors for manual-swing operation.
1. Door Construction: 2-inch overall thickness, with minimum 0.188-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 2. Door Design: Wide stile; 5-inch nominal width.
 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
 4. Finish: Clear anodic.
 5. Entrance Door Hardware: As specified in Section 087100 "Door Hardware."

2.7 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 "Joint Sealants."
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior for vision glass.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:

- 1. Comply with manufacturer's written instructions.
- 2. Do not install damaged components.
- 3. Fit joints to produce hairline joints free of burrs and distortion.
- 4. Rigidly secure nonmovement joints.
- 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
- 6. Seal joints watertight unless otherwise indicated.

- B. Metal Protection:

- 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
- 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

- C. Set sill members in manufacturer's watertight sill flashing pan in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

- D. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

- E. Install glazing as specified in Section 088000 "Glazing."

- F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

- 1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

- G. Install perimeter joint sealants as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.4 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

END OF SECTION 084113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Mechanical and electrified door hardware
 - 2. Electronic access control system components

- B. Section excludes:
 - 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 06 Section "Rough Carpentry"
 - 3. Division 06 Section "Finish Carpentry"
 - 4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
 - 5. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Stile and Rail Wood Doors"
 - d. "Interior Aluminum Doors and Frames"
 - e. "Aluminum-Framed Entrances and Storefronts"
 - f. "Stainless Steel Doors and Frames"
 - g. "Special Function Doors"
 - h. "Entrances"
 - 6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
 - 7. Division 13 Section "Radiation Protection" for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
 - 8. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.2 REFERENCES

- A. UL LLC
 - 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

- B. DHI - Door and Hardware Institute
 - 1. Sequence and Format for the Hardware Schedule
 - 2. Recommended Locations for Builders Hardware
 - 3. Keying Systems and Nomenclature
 - 4. Installation Guide for Doors and Hardware

- C. NFPA – National Fire Protection Association
 - 1. NFPA 70 – National Electric Code
 - 2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
 - 3. NFPA 101 – Life Safety Code
 - 4. NFPA 105 – Smoke and Draft Control Door Assemblies
 - 5. NFPA 252 – Fire Tests of Door Assemblies

- D. ANSI - American National Standards Institute
 - 1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
 - 2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
 - 3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
 - 4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
 - 5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.3 SUBMITTALS

- A. General:
 - 1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
 - 2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

- B. Action Submittals:
 - 1. Product Data: Submit 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 of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

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4. Door Hardware Schedule:
 - a. Submit 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 critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
 5. Key Schedule:
 - a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- 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. Final approved hardware schedule edited to reflect conditions as installed.
 - d. Final keying schedule
 - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
 - f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
- E. Inspection and Testing:
1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.4 QUALITY ASSURANCE

- A. Qualifications and Responsibilities:
1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
 3. Architectural Hardware Consultant: 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:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
 4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- B. Certifications:
1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, 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.
 2. Smoke and Draft Control Door Assemblies:

- a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - b. Comply with the 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.
 3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
 4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.
- C. Pre-Installation Meetings
1. Keying Conference
 - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.
 2. Pre-installation Conference
 - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Inspect and discuss electrical roughing-in for electrified door hardware.
 - d. Review sequence of operation for each type of electrified door hardware.
 - e. Review required testing, inspecting, and certifying procedures.
 - f. Review questions or concerns related to proper installation and adjustment of door hardware.
 3. Electrified Hardware Coordination Conference:
 - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- 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. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.6 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop 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.

1.7 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - a) Schlage L Series: 3 years
 - b) Schlage ND Series: 10 years
 - 2) Exit Devices
 - a) Von Duprin: 3 years
 - 3) Closers
 - a) LCN 4000 Series: 30 years
 - b) LCN Concealed: 15 years
 - 4) Automatic Operators
 - a) LCN: 2 years
 - b. Electrical Warranty
 - 1) Locks
 - a) Schlage: 1 year
 - b) Falcon: 1 year
 - 2) Exit Devices

- a) Von Duprin: 1 year
- 3) Closers
 - a) LCN: 2 years

1.8 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the 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. 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 MATERIALS

- A. Fabrication
 - 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
 - 2. Finish exposed 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 wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. 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.
- C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.3 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 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
4. 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
5. 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
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. 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.
8. 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
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.4 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.5 PIVOT SETS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide pivot sets complete with oil-impregnated top pivot, unless indicated otherwise.
2. Where offset pivots are specified, Provide one intermediate pivot for doors less than 91 inches (2311 mm) high and one additional intermediate pivot per leaf for each additional 30 inches (762 mm) in height or fraction thereof. Intermediate pivots spaced equally not less than 25 inches (635 mm) or not more than 35 inches (889 mm) on center, for doors over 121 inches (3073 mm) high.
3. Provide appropriate model where pivot sets are scheduled at fire rated openings.
4. Provide lead-lined model where pivot sets are specified at lead-lined doors.
5. Provide pivots with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electrified pivot nearest to electrified locking component. If manufacturer of electrified locking component requires another device for power transfer, then provide recommended power transfer device and appropriate quantity of pivots.
6. Provide mortar guard for each electric pivot specified, unless specified in hollow metal frame specification.

2.6 EMERGENCY HARDWARE

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide double lip strike and compatible emergency stop/release to allow door to swing open in opposite direction unless detailed otherwise. Size for specific frame depth.

Coordinate special latchbolt-hole location and special template, as required, to operate with mortise lock being used as specified.

2.7 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

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 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage ND series

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Cylinders: Refer to "KEYING" article, herein.
3. 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.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
 - a. Lever Design: RHO

2.9 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 99/33A series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.

3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. 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.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
17. Special Options:
 - a. SI
 - 1) Provide dogging indicators for visible indication of dogging status.
 - b. XP
 - 1) Rim Exit Devices: provide devices with non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress and Static Load Resistance of 2000 pounds.
 - c. QM
 - 1) Rim Exit Devices: provide devices with damper-controlled re-latching to reduce operational noise. Where lever trim is specified, provide damper controlled lever return.
 - d. HH
 - 1) Provide wind and impact rated hurricane exit devices and mullions certified to comply with Florida Building Code (FBC) TAS 201, 202, 203.
 - e. HW
 - 1) Provide wind rated hurricane exit devices and mullions certified to comply with ANSI-ASTM E330.
 - f. CX
 - 1) Provide delayed egress devices, where scheduled, that are UL 294 listed, meet National Fire Protection Association (NFPA) and International Building Code (IBC) governing delayed egress, and/or other local and national fire codes acceptable to authority having jurisdiction as required.
 - a) Provide non-handed and field sizable device with 3/4 (19mm) throw deadlocking latch bolt. Device incorporates an internal RX switch that detects attempt to exit from applying less than 15lbs to the push pad,

- which causes this switch to start an irreversible alarm cycle. Key switch in device is capable of arming, disarming, or resetting the device; and indicator lamp determines status of the device
- b) Provide devices capable of standard 15 second release delay and indefinite release delay as required by code, when tied into fire alarm system will release immediately when an alarm condition exists.
 - c) Provide devices with all control inputs – door position input, external inhibit input, fire alarm input; auxiliary locking; nuisance alarm and internal horn; and, remote signaling output self-contained in the device assembly.
- g. CVC
- 1) Provide cable-actuated concealed vertical latch system in two-point for non-rated or fire rated wood doors up to a 90 minute rating and less bottom latch (LBL) configuration for non-rated or fire rated wood doors up to 20 minute rating. Vertical rods not permitted.
 - a) Cable: Stainless steel with abrasive resistant coating. Conduit and core wire ends snap into latch and center slides without use of tools.
 - b) Wood Door Prep: Maximum 1 inch x 1.1875 inch x 3.875 inches top latch pocket and 1 inch x 1.1875 inch x 5 inches bottom latch pocket which does not require the use of a metal wrap or edge for non-rated or fire rated wood doors up to a 45 minute rating.
 - c) Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper- infiltrated steel, with molybdenum disulfide low friction coating.
 - d) Top Latchbolt: Minimum 0.38 inch (10 mm) and greater than 90-degree engagement with strike to prevent door and frame separation under high static load.
 - e) Bottom Latchbolt: Minimum of 0.44-inch (11 mm) engagement with strike.
 - f) Product Cycle Life: 1,000,000 cycles.
 - g) 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.
 - h) Latch release does not require separate trigger mechanism.
 - i) Cable and latching system characteristics:
 - i. Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
 - ii. Connected to exit device at single point in steel and aluminum doors, and two points for top and bottom latches in wood doors.
 - iii. Bottom latch height adjusted, from single point for steel and aluminum doors and two points for wood doors, after system is installed and connected to exit device, while door is hanging
 - iv. Bottom latch position altered up and down minimum of 2 inches (51 mm) in steel and aluminum doors without additional adjustment. Bottom latch deadlocks in every adjustment position in wood doors.
 - v. Top and bottom latches in steel and aluminum doors and top latch in wood doors may be removed while door is hanging.

2.10 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 6000 Series

- 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 that are tested to a minimum endurance test of 1,000,000 cycles.
 3. Where required, provide electric strikes UL Listed for fire doors and frames.
 4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.11 PASSIVE INFRARED MOTION SENSORS

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. Schlage SCAN II Series

- B. Requirements:
 1. Provide motion sensors as specified in hardware groups.

2.12 CYLINDERS

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. Schlage Everest 29 R SFIC

- B. Requirements:
 1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
 2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Patented Restricted Small Format: cylinder with small format interchangeable cores (SFIC) with restricted, patented keyway.
 3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
 4. Nickel silver bottom pins.

2.13 KEYING

- A. Scheduled System:
 1. New factory registered system:
 - a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
 2. Existing factory registered system:
 - a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

- B. Requirements:
1. Construction Keying:
 - a. Replaceable Construction Cores.
 - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - a) 3 construction control keys
 - b) 12 construction change (day) keys.
 - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
 2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
 - d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - e. Quantity: Furnish in the following quantities.
 - 1) Permanent Control Keys: 6.
 - 2) Master Keys: 6.
 - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
 - 4) Key Blanks: Quantity as determined in the keying meeting.

2.14 KEY CONTROL SYSTEM

- A. Manufacturers:
1. Scheduled Manufacturer:
 - a. Telkee
- B. Requirements:
1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.

- a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
- b. Provide hinged-panel type cabinet for wall mounting.

2.15 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 4040XP series

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 piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
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. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
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.

2.16 ELECTRO-MECHANICAL CLOSER/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. LCN

B. Requirements:

1. Provide single-point or multi-point hold-open electro-mechanical closer/holders as specified. Coordinate voltage requirements and provide transformer if necessary.
2. Provide closer/holders that function as full rack and pinion door closer when current is interrupted or continuous hold-open is not engaged.
3. Provide door closers with fully hydraulic, full rack and pinion action with high strength cylinder and full complement bearings at shaft.

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. Pressure Relief Valve (PRV) Technology: Not permitted.
8. 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.

2.17 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 4600 series

B. Requirements:

1. Provide low energy automatic operator units with hydraulic closer complying with ANSI/BHMA A156.19.
2. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Provide units with conventional door closer opening and closing forces unless power operator motor is activated. Provide door closer assembly with adjustable spring size, back-check, and opening and closing speed adjustment valves to control door
4. Provide units with on/off switch for manual operation, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay.
5. Provide drop plates, brackets, and adapters for arms as required for details.
6. Provide actuator switches and receivers for operation as specified.
7. Provide weather-resistant actuators at exterior applications.
8. Provide key switches with LED's, recommended and approved by manufacturer of automatic operator as required for function described in operation description of hardware group below. Cylinders: Refer to "KEYING" article, herein.
9. 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.
10. Provide units with vestibule inputs that allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.18 ELECTRO-MECHANICAL AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN Senior Swing 9500

B. Requirements:

1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI/BHMA 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 1 to 32 seconds, and logic terminal to interface with accessories, mats, and sensors.
3. Provide drop plates, brackets, and adapters for arms as required to suit details.
4. Provide motion sensors and/or actuator switches, and receivers 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.

2.19 DOOR TRIM

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Ives
- B. Requirements:
 1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.20 PROTECTION PLATES

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Ives
- B. Requirements:
 1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
 2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
 3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.21 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturers:
 - a. Glynn-Johnson
- B. Requirements:
 - 1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.22 DOOR STOPS AND HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
- B. Provide door stops at each door leaf:
 - 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
 - 2. Where a wall stop cannot be used, provide universal floor stops.
 - 3. Where wall or floor stop cannot be used, provide overhead stop.
 - 4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

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

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Zero International
- B. Requirements:
 - 1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
 - 2. 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.
 - 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.
 - 4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.24 SILENCERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
- 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:
 - a. LCN
- B. Requirements:
 1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.26 DOOR POSITION SWITCHES

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Schlage
- B. Requirements:
 1. Provide recessed or surface mounted type door position switches as specified.
 2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.27 COAT HOOKS

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Ives
- B. Provide coat hooks as specified.

2.28 FINISHES

- A. FINISH: BHMA 626/652 (US26D); EXCEPT:
 1. Hinges at Exterior Doors: BHMA 630 (US32D)
 2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
 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

- B. FINISH: BHMA 630 (US32D); EXCEPT:
1. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
 2. Door Closers: Powder Coat to Match
 3. Weatherstripping: Clear Anodized Aluminum
 4. 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. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. 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. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.
- J. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Line levers and roses with lead. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.
- K. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY 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. Connections to panel interface modules, controllers, and gateways.
 - 6. 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 & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Overhead Stops/ HOLDERS: Mount overhead stops/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.
- 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 and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.3 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 can 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 to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.4 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions 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.

3.5 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

98165 OPT0342043 Version 4

Legend:

📄 Link to catalog cut sheet

⚡ Electrified Opening

Hardware Group No. 01

For use on Door #(s):

108E

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	📄	US28	IVE
1	EA	POWER TRANSFER	EPT10	📄	⚡ 689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-OP-CON-24VDC	📄	⚡ 626	VON
1	EA	SFIC RIM CYLINDER	80-329	📄	626	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 12" STD	📄	630-316	IVE
1	EA	SURF. AUTO OPERATOR	9542 MS AS REQ (120/240 VAC)	📄	⚡ ANCL R	LCN
1	EA	WIRELESS ACTUATOR	8310-3818WF X 1-1/2" X 4-3/4" MOUNT ON INTERIOR	📄	⚡ 630	LCN
1	EA	WIRELESS ACTUATOR	8310-3853TWB 4 3/4 X 4 3/4 MOUNT ON BOLLARD	📄	⚡ 630	LCN
2	EA	BOLLARD POST	8310-866	📄		LCN
1	EA	GASKETING/SEALS	BY DOOR/FRAME MANUFACTURER			
1	EA	THRESHOLD	655A-223	📄	A	ZER
1	EA	WIRE HARNESS	CON-XXY (LOCK/EXIT TO HINGE JAMB)		⚡	SCH
1	EA	WIRE HARNESS	CON-XXP (FRAME TO POWER SUPPLY)	📄		SCH
1	EA	CREDENTIAL READER	BY SECURITY			
1	EA	POWER SUPPLY	PS914 900-2RS-FA 120/240 VAC	📄	⚡	VON
1	EA	WIRING DIAGRAMS	AS REQUIRED			
1	EA	DOOR CONTACT	BY SECURITY			

ALUMINUM STOREFRONT X AUTO OPERATOR AND CARD READER.

A FIELD VISIT IS REQUIRED TO CONFIRM WHICH HARDWARE CAN BE REUSED THAT WAS PROVIDED WITH THE CORE AND SHELL PORTION.

DOOR IS NORMALLY CLOSED AND LOCKED

PRESENTING A VALID CREDENTIAL WILL MOMENTARILY RETRACT THE LATCH TO THE QEL EXIT DEVICE ALLOWING ENTRY.

ONLY AFTER A VALID CREDENTIAL HAS BEEN PRESENTED, THEN THE AUTOMATIC DOOR OPERATOR CAN BE ACTIVATED BY WAVING HAND.

MECHANICAL KEY ACCESS IS ALSO AVAILABLE VIA A KEY IN THE CYLINDER.

DURING FIRE ALARM ACTIVATION OR POWER FAILURE, THE DOOR WILL REMAIN IN THE LOCKED POSITION FROM THE SECURED PULL SIDE. FAIL SECURE OPERATION

FREE EGRESS IS AVAILABLE AT ALL TIMES FROM INSIDE.

Hardware Group No. 01.1

For use on Door #(s):

1111 1115 1167

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY	☰	628	IVE
1	EA	STOREROOM LOCK	ND80BDC RHO	☰	626	SCH
1	EA	SFIC EVEREST CORE	80-037	☰	626	SCH
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	☰ ⚡	630	VON
1	EA	SURF. AUTO OPERATOR	9531 MS AS REQ (120/240 VAC) PULL SIDE MOUNT	☰ ⚡	ANCL R	LCN
2	EA	ACTUATOR, TOUCHLESS	8310-810DA WAVE	☰ ⚡	630	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	☰	630	IVE
1	EA	WALL STOP	WS406/407CVX	☰	630	IVE
3	EA	SILENCER	SR64	☰	GRY	IVE
1		CREDENTIAL READER	BY SECURITY			
1	EA	ELEVATION DRAWING	RISER DIAGRAM			
1	EA	WIRING DIAGRAM	POINT TO POINT AS REQ.			
1		DOOR CONTACT	BY SECURITY			
1		POWER SUPPLY	BY SECURITY			

DOOR IS NORMALLY CLOSED AND LOCKED

PRESENTING A VALID CREDENTIAL WILL RELEASE THE ELECTRIC STRIKE ALLOWING ENTRY.
ONLY AFTER A VALID CREDENTIAL HAS BEEN PRESENTED, THEN THE AUTOMATIC DOOR
OPERATOR CAN BE ACTIVATED BY WAVING HAND.

MECHANICAL KEY ACCESS IS ALSO AVAILABLE VIA A KEY IN THE CYLINDER.

DURING FIRE ALARM ACTIVATION OR POWER FAILURE, THE DOOR WILL REMAIN IN THE
LOCKED POSITION FROM THE SECURED PUSH SIDE. FAIL SECURE OPERATION
FREE EGRESS IS AVAILABLE AT ALL TIMES FROM INSIDE.

Hardware Group No. 02

For use on Door #(s):
2000A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY	☰	628	IVE
1	EA	ARCH. EXIT DEVICE	PDU8500	☰	BLK	ROC
1	EA	SFIC MORTISE CYL.	80-303	☰	626	SCH
1	EA	SFIC EVEREST CORE	80-037	☰	626	SCH
1	EA	ELECTRIC STRIKE	ESK-1600 SGL	☰	⚡ BLK	HES
1	EA	SURF. AUTO OPERATOR	9531 MS AS REQ (120/240 VAC) PULL SIDE MOUNT	☰	⚡ ANCL R	LCN
2	EA	ACTUATOR, TOUCHLESS	8310-810DA WAVE	☰	⚡ 630	LCN
1	EA	WALL STOP	WS406/407CVX	☰	630	IVE
1		CREDENTIAL READER	BY SECURITY			
1	EA	DESK MOUNT BUTTON	660-PB	☰	⚡ 628	SCE
1	EA	ELEVATION DRAWING	RISER DIAGRAM			
1	EA	WIRING DIAGRAM	POINT TO POINT AS REQ.			
1		DOOR CONTACT	BY SECURITY			
1		POWER SUPPLY	BY SECURITY			
1		SEALS	BY ALUM DOOR SUPPLIER			

ALUMINUM MEDIUM STILE DOOR AND FRAME.

DOOR IS NORMALLY CLOSED AND LOCKED

PRESENTING A VALID CREDENTIAL WILL RELEASE THE ELECTRIC STRIKE ALLOWING ENTRY.
ONLY AFTER A VALID CREDENTIAL HAS BEEN PRESENTED, THEN THE AUTOMATIC DOOR
OPERATOR CAN BE ACTIVATED BY WAVING HAND.

MECHANICAL KEY ACCESS IS ALSO AVAILABLE VIA A KEY IN THE CYLINDER.

PRESSING THE PUSH BUTTON WILL RELEASE THE ELECTRIC STRIKE ALLOWING EMPLOYEES
TO BUZZ PATIENTS INSIDE.DURING FIRE ALARM ACTIVATION OR POWER FAILURE, THE DOOR WILL REMAIN IN THE
LOCKED POSITION FROM THE SECURED PUSH SIDE. FAIL SECURE OPERATION
FREE EGRESS IS AVAILABLE AT ALL TIMES FROM INSIDE.

Hardware Group No. 03

For use on Door #(s):

2000B 2000C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY TWP CON	☰	628	IVE
1	EA	ARCH. EXIT DEVICE	PDU8500	☰	BLK	ROC
1	EA	SFIC EVEREST CORE	80-037	☰	626	SCH
1	EA	ELECTRIC STRIKE	ESK-1600 SGL	☰	BLK	HES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	☰	689	LCN
1	EA	WALL STOP	WS406/407CVX	☰	630	IVE
1		CREDENTIAL READER	BY SECURITY			
1	EA	DESK MOUNT BUTTON	660-PB	☰	628	SCE
1	EA	DESK MOUNT BUTTON	660-PB	☰	628	SCE
1	EA	DOOR CONTACT	679-05HM	☰	BLK	SCE
1	EA	ELEVATION DRAWING	RISER DIAGRAM			
1	EA	WIRING DIAGRAM	POINT TO POINT AS REQ.			
1		DOOR CONTACT	BY SECURITY			
1		POWER SUPPLY	BY SECURITY			
1		SEALS	BY ALUM DOOR SUPPLIER			

ALUMINUM DR/FR

DOOR IS NORMALLY CLOSED AND LOCKED

PRESENTING A VALID CREDENTIAL WILL RELEASE THE ELECTRIC STRIKE ALLOWING ENTRY.
MECHANICAL KEY ACCESS IS ALSO AVAILABLE VIA A KEY IN THE CYLINDER.PRESSING THE PUSH BUTTON WILL RELEASE THE ELECTRIC STRIKE ALLOWING EMPLOYEES
TO BUZZ PATIENTS INSIDE.DURING FIRE ALARM ACTIVATION OR POWER FAILURE, THE DOOR WILL REMAIN IN THE
LOCKED POSITION FROM THE SECURED PUSH SIDE. FAIL SECURE OPERATION
FREE EGRESS IS AVAILABLE AT ALL TIMES FROM INSIDE.

Hardware Group No. 04

For use on Door #(s):

1123	1170	1224	1300	2110A	2200A
2200B	2300A	2300C	2309A	2400A	2406A
2500A	2500B	2516			

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5	☰	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	☰ ⚡	652	IVE
1	EA	EU STOREROOM LOCK	ND80BDCEU RHO CON 12V/24V DC	☰ ⚡	626	SCH
1	EA	SFIC EVEREST CORE	80-037	☰	626	SCH
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
1	EA	WALL STOP	WS406/407CVX	☰	630	IVE
3	EA	SILENCER	SR64	☰	GRY	IVE
1		CREDENTIAL READER	BY SECURITY			
1	EA	ELEVATION DRAWING	RISER DIAGRAM			
1	EA	WIRING DIAGRAM	POINT TO POINT AS REQ.			
1		DOOR CONTACT	BY SECURITY			
1		POWER SUPPLY	BY SECURITY			

DOOR IS NORMALLY CLOSED AND LOCKED
PRESENTING A VALID CREDENTIAL WILL MOMENTARILY UNLOCK THE LEVER ALLOWING ENTRY.








MECHANICAL KEY ACCESS IS ALSO AVAILABLE VIA A KEY IN THE CYLINDER.
DURING FIRE ALARM ACTIVATION OR POWER FAILURE, THE DOOR WILL REMAIN IN THE LOCKED POSITION FROM THE SECURED PUSH SIDE. FAIL SECURE OPERATION
FREE EGRESS IS AVAILABLE AT ALL TIMES FROM INSIDE.

Hardware Group No. 05

For use on Door #(s):

1164 1169 2303

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	 ↗	652	IVE
1	EA	EU STOREROOM LOCK	ND80BDCEU RHO CON 12V/24V DC	 ↗	626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
1	EA	TRACK ARM CLOSER	4040XPT		689	LCN
			PULL SIDE MOUNT			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
1		CREDENTIAL READER	BY SECURITY			
1	EA	ELEVATION DRAWING	RISER DIAGRAM			
1	EA	WIRING DIAGRAM	POINT TO POINT AS REQ.			
1		DOOR CONTACT	BY SECURITY			
1		POWER SUPPLY	BY SECURITY			

DOOR IS NORMALLY CLOSED AND LOCKED

PRESENTING A VALID CREDENTIAL WILL MOMENTARILY UNLOCK THE LEVER ALLOWING ENTRY.

MECHANICAL KEY ACCESS IS ALSO AVAILABLE VIA A KEY IN THE CYLINDER.

DURING FIRE ALARM ACTIVATION OR POWER FAILURE, THE DOOR WILL REMAIN IN THE LOCKED POSITION FROM THE SECURED PUSH SIDE. FAIL SECURE OPERATION
FREE EGRESS IS AVAILABLE AT ALL TIMES FROM INSIDE.

Hardware Group No. 06

For use on Door #(s):

1210A 1210B 1303A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 5 X 4.5 CON TW8		652	IVE
1	EA	EU STOREROOM LOCK	ND80BDCEU RHO CON 12V/24V DC		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
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
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
1		CREDENTIAL READER	BY SECURITY			
1	EA	ELEVATION DRAWING	RISER DIAGRAM			
1	EA	WIRING DIAGRAM	POINT TO POINT AS REQ.			
1		DOOR CONTACT	BY SECURITY			
1		POWER SUPPLY	BY SECURITY			

DOOR IS NORMALLY CLOSED AND LOCKED

PRESENTING A VALID CREDENTIAL WILL MOMENTARILY UNLOCK THE LEVER ALLOWING ENTRY.

MECHANICAL KEY ACCESS IS ALSO AVAILABLE VIA A KEY IN THE CYLINDER.

DURING FIRE ALARM ACTIVATION OR POWER FAILURE, THE DOOR WILL REMAIN IN THE LOCKED POSITION FROM THE SECURED PUSH SIDE. FAIL SECURE OPERATION
FREE EGRESS IS AVAILABLE AT ALL TIMES FROM INSIDE.

Hardware Group No. 07

For use on Door #(s):
1120

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	☰	652	IVE
1	EA	PRIVACY LOCK	ND40S RHO	☰	626	SCH
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	☰ ⚡	630	VON
1	EA	SURF. AUTO OPERATOR	4642 WMS 120 VAC PUSH SIDE MOUNT	☰ ⚡	689	LCN
2	EA	TOUCHLESS RESTROOM KIT	8310-2410	☰ ⚡	630	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	☰	630	IVE
3	EA	SILENCER	SR64	☰	GRY	IVE
1	EA	ELEVATION DRAWING	RISER DIAGRAM			
1	EA	WIRING DIAGRAM	POINT TO POINT AS REQ.			
1		POWER SUPPLY	BY SECURITY			

TOUCHLESS RESTROOM KIT 8310-2410 INCLUDES CONTROL BOX, POWER SUPPLY, TOUCHLESS SWITCHES, ELECTRIC STRIKE AND A DOOR POSITION SWITCH.

DOOR IS NORMALLY CLOSED AND UNLOCKED. PRIVACY LOCKING LEVER SET. THE AUTOMATIC DOOR OPERATOR CAN BE ACTIVATED BY WAVING HAND OVER THE TOUCHLESS SENSOR WHICH WILL RELEASE THE ELECTRIC STRIKE AND INITIATE THE DOOR OPERATOR..

ONCE OCCUPANT IS INSIDE, THE DOOR CAN BE LOCKED BY WAVING HAND OVER THE INTERIOR SENSOR (WAVE TO LOCK). THIS WILL MOMENTARILY DISABLE THE OUTSIDE WAVE SWITCH AND THE ELECTRIC STRIKE. MAINTAINING PRIVACY FOR THE OCCUPANT. THE DOOR POSITION SWITCH WILL MONITOR THE STATUS OF THE DOOR. OPEN OR CLOSED. FREE EGRESS IS AVAILABLE AT ALL TIMES FROM INSIDE.

Hardware Group No. 08

For use on Door #(s):
1168

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY	☰	628	IVE
1	EA	PASSAGE SET	ND10S RHO	☰	626	SCH
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	☰	⚡ 630	VON
1	EA	SURF. AUTO OPERATOR	9531 MS AS REQ (120/240 VAC) PULL SIDE MOUNT	☰	⚡ ANCL R	LCN
2	EA	ACTUATOR, TOUCHLESS	8310-810DA WAVE		⚡ 630	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	☰	630	IVE
3	EA	SILENCER	SR64	☰	GRY	IVE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	☰	⚡ BLK	SCE
1	EA	ELEVATION DRAWING	RISER DIAGRAM			
1	EA	WIRING DIAGRAM	POINT TO POINT AS REQ.			
1		POWER SUPPLY	BY SECURITY			

DOOR IS NORMALLY CLOSED AND UNLOCKED. PASSAGE LEVER SET.
 THE AUTOMATIC DOOR OPERATOR CAN BE ACTIVATED BY WAVING HAND WHICH WILL
 RELEASE THE ELECTRIC STRIKE AND INITIATE THE DOOR OPERATOR..
 IF SOMEONE IS STANDING IN THE PATH OF THE INSWINGING DOOR (PULL SIDE), THE MOTION
 SENSOR (SCAN II) WILL MOMENTARILY DISABLE THE WAVE ACTUATOR ON THE OPPOSITE
 SIDE TO PREVENT IMPACT.
 FREE EGRESS IS AVAILABLE AT ALL TIMES FROM INSIDE.

Hardware Group No. 09 - LEAD LINED X CARD READER

For use on Door #(s):
2216

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PIVOT SET	7215 SET		626	IVE
1	EA	ELECT INTERMEDIATE PIVOT	7215PT INT		626	IVE
1	EA	PUSH/PULL LATCH	HL6 9092EL RX 2 3/4" B A L		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-NH-A ADHESIVE PUSH SIDE MOUNT		US32D	IVE
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1		CREDENTIAL READER	BY SECURITY			
1		RISER DIAGRAM	ELEVATION DRAWING			
1	EA	WIRING DIAGRAM	POINT TO POINT AS REQ.			
1		DOOR CONTACT	BY SECURITY			
1		POWER SUPPLY	BY SECURITY			

DOOR IS NORMALLY CLOSED AND LOCKED
PRESENTING A VALID CREDENTIAL WILL MOMENTARILY UNLOCK THE LEVER ALLOWING
ENTRY.

MECHANICAL KEY ACCESS IS ALSO AVAILABLE VIA A KEY IN THE CYLINDER.
DURING FIRE ALARM ACTIVATION OR POWER FAILURE, THE DOOR WILL REMAIN IN THE
LOCKED POSITION FROM THE SECURED PUSH SIDE. FAIL SECURE OPERATION
FREE EGRESS IS AVAILABLE AT ALL TIMES FROM INSIDE.

IMAGING EQUIPMENT WILL NOT RUN IF DOORS ARE OPEN - EQUIPMENT PROVIDER TO SUPPLY
ANY EMERGENCY SHUT OFF COMPONENTS NECESSARY TO SHUT DOWN EQUIPMENT IN THE
EVENT THE DOOR IS OPEN DURING USE.

Hardware Group No. 10 - LEAD LINED X NO CARD READER

For use on Door #(s):
1213 1217

Provide each SGL door(s) with the following:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PIVOT SET	7215 SET		626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT		626	IVE
1	EA	LEAD LINED PASSAGE SET	ND10S RHO XN12-307		626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-NH-A ADHESIVE		US32D	IVE
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. 11 - LEAD LINED X NO CARD READER

For use on Door #(s):

1218

Provide each SGL door(s) with the following:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PIVOT SET	7215 SET		626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT		626	IVE
1	EA	STOREROOM LOCK	ND80BDC RHO XN12-307		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-NH-A ADHESIVE		US32D	IVE
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. 12

For use on Door #(s):

1220

Provide each DE door(s) with the following:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		628	IVE
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR-499F		US26D	VON
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBRAFL-499F		626	VON
2	EA	SURFACE CLOSER	4040XPT DBL EGRESS		689	LCN
4	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	SET BRUSH MEETING STILES	8193AA		AA	ZER

Hardware Group No. 13

For use on Door #(s):

1220







Provide each DE door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		628	IVE
2	EA	PANIC HARDWARE	LD-9927-EO-LBR		626	VON
2	EA	TRACK ARM CLOSER	4040XPT PULL SIDE MOUNT		689	LCN
4	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	SET BRUSH MEETING STILES	8193AA		AA	ZER

Hardware Group No. 14

For use on Door #(s):
1138








Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	99-L-BE-06		626	VON
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
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 15

For use on Door #(s):
1133 1136 1159A 2309B 2316 2505
2608 2609 2617 2621








Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80BDC RHO		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
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
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 16

For use on Door #(s):
1159B 1198 1199








Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80BDC RHO		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
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
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. 16.1

For use on Door #(s):
1225








Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80BDC RHO		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
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
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 17

For use on Door #(s):
1181 1222

Provide each SGL door(s) with the following:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80BDC RHO		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA PA MOUNT		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

180° DEGREE DOOR SWING PA CLOSER MOUNT

Hardware Group No. 18

For use on Door #(s):
1182

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	MANUAL FLUSH BOLT	FB458 12"		626	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D		626	IVE
1	EA	STOREROOM LOCK	ND80BDC RHO		626	SCH
2	EA	OH STOP	90S		630	GLY
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	SET BRUSH MEETING STILES	8193AA		AA	ZER

Hardware Group No. 19

For use on Door #(s):
1114A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50BDC RHO		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	WALL STOP	WS406/407CVX		630	IVE
1		SEALS	BY ALUM DOOR SUPPLIER			

ALUMINUM DR/FR

Hardware Group No. 19.5

For use on Door #(s):
1303B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50BDC RHO		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	COAT AND HAT HOOK	571		626	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 20

For use on Door #(s):

1121	1122	1174	1189	1190	1203
1204	1205	1206	1207	1209	1304
2101	2102	2104	2108	2302	2603
2605	2607	2610	2611	2612	2613
2614	2616	2618	2619	2620	2622
2623	2628				

Provide each SGL door(s) with the following:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50BDC RHO		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	COAT AND HAT HOOK	571		626	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 21

For use on Door #(s):

2103 2106 2107

Provide each SGL door(s) with the following:











QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50BDC RHO		626	SCH
1	EA	SFIC EVEREST CORE	80-037		626	SCH
1	EA	TRACK ARM CLOSER	4040XPT PULL SIDE MOUNT		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 22

For use on Door #(s):

1118	1134	1147	1157	1180	1184
1187	1211	2105	2109	2203	2214
2315	2401	2407	2511		

Provide each DA door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PIVOT SET	7253 SET CENTER HUNG		626	IVE
1	EA	PRIVACY LOCK	ND40S RHO		626	SCH
1	EA	EMER STOP LATCH ASSY	299AL		US32D	IVE
1	EA	RESCUE STRIKE ONLY	299RS CENTER HUNG		US32D	IVE
1	EA	CONCEALED OH STOP	100S DBL ACTING		630	GLY
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
2	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	ADHESIVE PILE SEAL	137PBK PSA STICK ON LOCK		BK	ZER
1	EA	BRUSH PERIMETER SEAL	398V APPLY ON HINGE AND STRIKE SIDE		V	ZER
1	EA	COAT AND HAT HOOK	571		626	IVE

RESCUE STRIKE HARDWARE APPLICATION

Hardware Group No. 23

For use on Door #(s):

1166	1171	1172	1208	1302	2606
2615	2625	2626			

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PUBLIC RESTRM W/OCCUPANCY INDICATOR	H2171 DAN		626	FAL
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	COAT AND HAT HOOK	571		626	IVE

STAFF RESTROOMS

Hardware Group No. 24

For use on Door #(s):

1124A	1126	1131	1132	1179	1195
2110B	2202	2204	2205	2207	2208
2209	2210	2211	2212	2213	2215
2305	2307	2308	2310	2311	2312
2313	2314	2318	2319	2321	2322
2403	2404	2406B	2408	2409	2412
2413	2414	2415	2502	2503	2506
2507	2508	2509	2510	2513	2514
2604	2627				

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 25

For use on Door #(s):

1200A	1200B
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Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 26

For use on Door #(s):

1128 1129 1135 1137 1175 1178

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	OH STOP	90S J		630	GLY
3	EA	SILENCER	PULL SIDE MOUNT SR64		GRY	IVE


Hardware Group No. 27 - Not Used

Hardware Group No. 28

For use on Door #(s):

1114B 1124B

Provide each BD door(s) with the following:


QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	SET BARN SLIDING DOOR HW	2610F x 1125 Hangers			JOH
1	EA	SET DOOR PULLS BTB	PR 8103EZHD 8"		630- 316	IVE

Hardware Group No. 28.1

For use on Door #(s):

1114C 2402

Provide each BD door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	SET BARN SLIDING DOOR HW	2610F x 1125 Hangers			JOH
1	EA	SLIDING OFFICE LOCK	XGT-346-PD9550		630	
1	EA	SFIC EVEREST CORE	80-037		626	SCH
1	EA	WALL STRIKE BOX	WS90L INOX		630	

Hardware Group No. 28.2 - Not Used

Hardware Group No. 28.3

For use on Door #(s):

1301 2201

Provide each BD door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	SET BARN SLIDING DOOR HW	2610F x 1125 Hangers		JOH
1	EA	CLASSROOM SLIDING LOCK	XGT-346-PD9570 INOX	630	
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	WALL STRIKE BOX	WS90L INOX	630	

Hardware Group No. 29

For use on Door #(s):

1117A 1193

Provide each PD door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	POCKET DOOR TRACK & HW	204070PF (Johnson)		
1	EA	SET DOOR PULLS BTB	PR 8103EZHD 8" PASSAGE	630-316	IVE

PASSAGE FUNCTION

Hardware Group No. 30

For use on Door #(s):

1163 1165

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	SFIC MORTISE CYL.	80-301 X L583-255 EV B 36-083 36-082-025	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	BALANCE OF HDWE	BY ICU DOOR SUPPLIER		

ICU SLIDING DOORS

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Storefront framing.
 2. Glazed entrances.
 3. Interior borrowed lites.

1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

- C. Glazing Accessory Samples: For sealants, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installers and sealant testing agency.
- B. Product Certificates: For glass and glazing products, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass, coated glass, glazing sealants, and glazing gaskets.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
1. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 2. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Heat-Treated Float Glass: ASTM C1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 2. For uncoated glass, comply with requirements for Condition A.
 3. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.3 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. Silicone complying with ASTM C1115.
 - 2. Thermoplastic polyolefin rubber complying with ASTM C1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.4 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 - 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. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 890.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco Incorporated; Spectrem 1.

2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

2.8 MONOLITHIC-GLASS TYPES

- A. Clear, Float Glass - **CFG**: Clear float glass.
1. Thickness: 6.0 mm.
- B. Tempered Clear, Float Glass – **TFG**: Clear, fully tempered float glass.
1. Thickness: 6.0 mm.

2. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- B. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- C. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 088113 - DECORATIVE GLASS GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Patterned glass.
 2. Laminated glass.
 3. Glass with decorative film overlay.

1.2 DEFINITION

- A. Glass Thickness: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation 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. Review temporary protection requirements for glazing during and after installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For decorative glass. Show fabrication and installation details. Include the following:
1. Size and location of penetrations.
 2. Glazing method.
 3. Mounting method.
 4. Attachments to other work.
 5. Full-size details of edge-finished profiles.
- C. Glass Samples: For the following products, 12 inches square:

1. Each type of decorative glass.
2. Each edge treatment on type of decorative glass.
3. Each decorative film overlay on type of decorative glass.
4. Each applied coating on type of decorative glass.

D. Glazing Accessory Samples: For sealants, in 12-inch lengths.

E. Decorative Glazing Schedule: List decorative glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of decorative glass.

C. Preconstruction adhesion and compatibility test report.

D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of decorative glass to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.

B. Sealant Testing Agency Qualifications: An independent testing agency qualified in accordance with ASTM C1021 to conduct the testing indicated.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect decorative glass and glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Retain packaging and sequencing numbers for decorative glass units.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install decorative glass until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.11 WARRANTY

- A. Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS OF DECORATIVE GLASS

- A. Manufacturers: Subject to compliance with requirements, provide Basis-of-Design products by the following:
 - 1. Skyline Design, 1240 N Homan Ave., Chicago, IL 60651 | T: 773-278-4660 | F: 773-278-3548 | Email: sales@skydesign.com.
- B. Source Limitations for Glass: Obtain each type of decorative glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer, for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Decorative glass installed adjacent to walking surfaces shall withstand the following design loads within limits and under conditions indicated:

1. Differential deflection of adjacent unsupported edges shall not exceed glass thickness when subjected to 50 lbf/ft. applied horizontally to one panel at any point up to 42 inches above the adjacent walking surface.
 2. Base design on thickness at thinnest part of the glass.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with glass product manufacturers' written instructions and NGA's "GANA Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with requirements indicated. Where heat-strengthened glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with requirements indicated. Where fully tempered glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Fully Tempered Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- B. Patterned Glass: ASTM C1036, Type II, Class 1 (clear) or Class 2 (tinted) as indicated, Form 3; finish, pattern, and quality as indicated.
- C. Tempered Patterned Glass: ASTM C1048, Kind FT (fully tempered), Type II, Class 1 (clear) or Class 2 (tinted) as indicated, Form 3; finish, pattern, and quality as indicated.
- D. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

2.5 GLAZING MATERIALS

- A. Glazing Sealants, Tapes, and Miscellaneous Glazing Materials: As specified in Section 088000 "Glazing."
1. Colors: As selected by Architect from manufacturer's full range.

2.6 HARDWARE FOR GLASS INSTALLATION

- A. Hardware: Edge grips, Glass panel to ceiling clamps/connectors, Glass panel to floor clamps/connectors, Glass panel to wall clamps/connectors, Glass to glass panel clamp/connectors, Panel support bars, Stand-off display system with caps, Continuous top track, or Continuous floor track.
 - 1. Dimensions: As required for glass thickness.
 - 2. Material and Finish: As selected by Architect from manufacturer's full range.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Gaskets: Manufacturer's standard, compatible with decorative glass type indicated.
- D. Anchors and Inserts: Provide devices as required for hardware installation. Provide metal expansion-bolt devices for drilled-in-place anchors.

2.7 DECORATIVE GLASS FABRICATION

- A. Fabricate decorative glass and provide other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with product manufacturer's written instructions and with referenced glazing standard.
- B. Edge Finishing: Finish edges smooth and polished, without chips, scratches, or warps.
 - 1. Finished Edge: Flat polished.
- C. Decorative Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in pattern indicated on Drawings to the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine decorative glass framing members, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Minimum required face or edge clearances.
 - 3. Effective sealing between joints of decorative glass framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate orientation of outer surfaces as indicated on Drawings. Label or mark units as needed so that surface orientation is readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 INSTALLATION

- A. Set decorative glass units in each series true in line with uniform orientation, pattern, draw, bow, and similar characteristics.
- B. Set glass lites with proper orientation so that each outer surface faces the direction indicated on Drawings.
- C. Set decorative glass in locations indicated on Drawings. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces and building structure.
- D. Set decorative glass in locations indicated on the Drawings.

3.4 GLAZING, GENERAL

- A. Decorative Glass: Install glazing as specified in Section 088000 "Glazing."
- B. Comply with combined written instructions of manufacturers of glass, gaskets, sealants, tapes, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is more than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and

- glazing tapes are used that have demonstrated ability to maintain required face clearances, and to comply with system performance requirements.
2. Provide 1/8-inch- minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.6 DECORATIVE GLASS SCHEDULE

- A. Patterned Glass (**GL-1**), (**GL-3**) : Low-iron, tempered patterned glass, Finish F1 (patterned one side), Quality-Q5.
 1. Basis-of-Design Product: Skyline Design; Satinlite Starfire Tempered, Sateen C Eco-Etch.
 2. Glass Thickness:
 - a. (**GL-1**): 1/2-inch (12 mm).
 - b. (**GL-3**): 1/4-inch (6 mm).
 3. Pattern: As indicated in the Arch – Material Finishes (Interior) legend on the Drawings.
 4. Product Color: As indicated in the Arch – Material Finishes (Interior) legend on the Drawings.
 5. Safety glazing required.
- B. Decorative Glass Panel (**GL-2**)
 1. Basis-of-Design Product: Skyline Design; Starfire Tempered.
 2. Glass Type: Clear, low-iron, fully tempered float glass.
 3. Glass Thickness: 1/4-inch (6 mm).
 4. Product Color: Clear.
 5. Safety glazing required.
- C. Laminated Glass (**GL-5**), (**GL-6**): Laminated glass.

1. Basis-of-Design Product: Skyline Design; Starfire Tempered, Sateen FS.
2. Construction: Two plies of low-iron, fully tempered float glass.
3. Product Color: As indicated in the Arch – Material Finishes (Interior) legend on the Drawings.
4. Thickness of Each Glass Ply: 6 mm.
5. Interlayer Type: Laminate glass with PVB interlayer to comply with interlayer manufacturer's written instructions.
6. Interlayer Thickness: 0.030 inch.
7. Interlayer Color and Pattern: As indicated in the Arch – Material Finishes (Interior) legend on the Drawings.
8. Safety glazing required.

D. Privacy Glass (**GL-4**)

1. Basis-of-Design Product: Skyline Design; Satinlite Starfire Tempered.
2. Glass Type: Low iron, fully tempered float glass.
3. Product Color: White.
4. Glass Thickness: 1/4-inch (6 mm).
5. Pattern: As indicated in the Arch – Material Finishes (Interior) legend on the Drawings.
6. Safety glazing required.

END OF SECTION 088113

SECTION 092116.13 - EXTRUDED ALUMINUM PARTITION GAP CLOSURE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes drywall accessories or noise control components as shown on the Architectural Drawings.

1.2 PERFORMANCE REQUIREMENTS

- A. All components of the Mullion Mate® – Series 60 – Partition Gap Closure shall be provided by one (1) Manufacturer to ensure single source responsibility and quality control.

1.3 ACTION SUBMITTALS

- A. Submission must be made within ten (10) working days of the General Contract Award to avoid project delay.
- B. Product Data: Submit Manufacturer's:
 - 1. Product Specifications.
 - 2. Detail Drawings.
 - 3. Installation Instructions.
- C. Shop Drawings shall show dimensions, sizes, thickness, finishes, joining, attachments, and relationship of adjoining work.
- D. Samples:
 - 1. Submit samples consisting of 12-inch Mullion Mate® – Series 60 Partition Gap Closure and finish as specified, as well as accessories.

1.4 INFORMATION SUBMITTALS

- A. Certification: Submit certification from Manufacturer of accessory attesting that products comply with specified requirements, including finish as specified.
- B. Qualification Data:
 - 1. Firms specified in "Quality Assurance" Article must demonstrate their capabilities and experience by including lists of completed projects with project names and addresses, names and addresses of Architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Firm with manufacturing and delivery capacity required for the project shall have successfully completed at least ten (10) projects within the past five (5) years, utilizing systems, materials, and techniques as herein specified.
- B. Fabricator must own and operate its own manufacturing facilities for all metal components. Systems consisting of components from a variety of Manufacturers will not be considered or accepted.
- C. Manufacturer/Fabricator must own and operate its own Painting and Finishing facility to assure single source responsibility and quality control.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be protected during fabrication, shipment, site storage, and erection to prevent damage from other trades. Store accessories inside a well-ventilated area, away from uncured concrete and masonry, and protected from the weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.7 WARRANTY

- A. Furnish Manufacturer's warranty.
 - 1. Warranty that materials furnished will perform as specified for a period of not less than one (1) year from date of material shipment when installed in accordance with Manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable System: Mullion Mate[®] – Series 60 Extruded Aluminum Partition Gap Closure shall be manufactured by Gordon, Inc. For all inquiries contact, Gordon, Inc., 5023 Hazel Jones Road, Bossier City, LA 71111, (800) 747-8954.
- B. The listed manufacturer shall not be construed as closing specifications to other prospective manufacturers, but rather as establishing a level of quality in a metal system. Other systems may be submitted for approval, as provided for in the specifications at least ten (10) working days prior to submission of bids. Companies desiring to submit a proposal shall submit all descriptive information of the system proposed including photographs and Shop Drawings of at least three (3) projects similar in detail and scope.

2.2 MATERIALS

- A. Mullion Mate[®] – Series 60 Extruded Aluminum Partition Gap Closures are preassembled and spring loaded to provide a tight fit for vertical junctures of partitions and window walls. They are

sound tested to a composite STC ranging from 38 to 60 with acoustical batts for sound attenuation and sound dampening materials.

- B. Materials: Aluminum extrusions: 6063-T5 or T6 temper, tensile strength 31 KSI (ASTM B221/B221M).

1. Mullion Mate[®] 4 (Series 60) for openings 4 to 5.4 inches.
2. Mullion Mate[®] 5.5 (Series 60) for openings 5.5 to 7 inches.
3. Lengths up to 16 feet.

- C. Accessories:

1. Mullion Mate[®] End Caps

- a. Extruded:

- 1) MMEC-375 for 3-3/4-inch-thick walls.
- 2) MMEC-487 for 4-7/8-inch-thick walls.
- 3) MMEC-600 for 6-inch walls.
- 4) MMEC-725 for 7-1/4-inch-thick walls.

- b. Brake-Formed:

- 1) MMECBF-518 for 5-1/8-inch-thick walls.
- 2) MMECBF-514 for 5-1/4-inch-thick walls.
- 3) MMECBF-512 for 5-1/2-inch-thick walls.
- 4) MMECBF-618 for 6-1/8-inch-thick walls.
- 5) MMECBF812 for 8-1/2-inch-thick walls.

- D. General: Provide metals free from surface blemishes where exposed to view in finished unit. Surfaces that exhibit pitting, seam marks, roller marks, stains, and discolorations, or other imperfections on finished units are not acceptable. All metal shall be of the highest grade commercial type.

2.3 FINISHES

- A. All material shall be in a finish chosen from one of the following options:

1. Field Paintable.
2. Factory-Clear Anodized.
3. AAMA 2604 and AAMA 2605 super-durable polyester, antimicrobial Powder Coat, color and gloss discretionary

2.4 FABRICATION

- A. Provide Extruded Aluminum Partition Gap Closure - Series 60 in specified lengths and size to fit specified openings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examination of Surfaces: Installer must examine conditions under which work is to be performed and must notify Contractor in writing of unsatisfactory conditions.
- B. Verify that field measurements and block-out dimensions are as shown on Shop Drawings.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the Manufacturer to achieving the best result for the project conditions.

3.3 INSTALLATION

- A. General: Comply with Manufacturer's printed instructions, governing regulations for Seismic Codes, and any other regulations applicable to work.
- B. Space Enclosure: Do not install any work until space is enclosed and weatherproofed, wet-work in space is completed and nominally dry, work above ceilings is complete, and temperature and humidity shall be continuously maintained at values near those of final occupancy.

3.4 CLEANING

- A. Follow Manufacturer's cleaning instructions for specified finish.

3.5 PROTECTION

- A. Procedures: Advise the Contractor of procedures required to protect the finished work from damage during the remainder of the construction period.
- B. Damage to Finished Work: Finished units shall be without damage. Damage shall be repaired by the Contractor at the expense of the party damaging the material, as in accordance with the contract requirements.

END OF SECTION 092116.13

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
 - 2. Protective Coating: ASTM A653/A653M, G40 Coating with equivalent corrosion resistance of ASTM A653/A653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.
 - 1. Steel Studs and Tracks:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) CEMCO; California Expanded Metal Products Co.
 - 2) ClarkDietrich.
 - 3) MarinoWARE.
 - b. Minimum Base-Steel Thickness: 0.0179 inch.
 - c. Depth: As indicated on Drawings.
- C. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.

- b. Fire Trak Corp.
 - c. MarinoWARE.
 - d. Metal-Lite.
- D. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch- wide flanges.
- 1. Depth: 1-1/2 inches.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C645.
- 1. Minimum Base-Steel Thickness: 0.0179 inch.
 - 2. Depth: As indicated on Drawings.
- F. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
- 1. Configuration: Asymmetrical or hat shaped.
- G. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
- 1. Depth: 3/4 inch.
 - 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
 - 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.2 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
- 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: Torque-controlled, expansion anchor.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches.
- F. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 2. Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: 0.0179 inch.
 - b. Depth: As indicated on Drawings.
 3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.
 - a. Minimum Base-Steel Thickness: 0.0179 inch.
 4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
 2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
 3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated.
- B. Install studs so flanges within framing system point in same direction.
- C. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- D. Direct Furring:
1. Screw to wood framing.
 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches o.c.
 2. Carrying Channels (Main Runners): 48 inches o.c.
 3. Furring Channels (Furring Members): 16 inches o.c.

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- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.3 QUALITY ASSURANCE

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Source Limitations: Provide gypsum products manufactured within the United States from materials free of sulfur, formaldehyde or other deleterious chemicals. Natural gypsum ore shall be mined in North America. Synthetic (Byproduct) gypsum shall be pure calcium sulfate from domestic sources.
- B. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. CertainTeed Corp.
 - 3. Georgia-Pacific Gypsum LLC.
 - 4. Lafarge North America Inc.
 - 5. National Gypsum Company.
 - 6. Temple-Inland.

7. USG Corporation.
- B. Gypsum Wallboard: ASTM C1396/C1396M.
 1. Thickness: 5/8 inch.
 2. Long Edges: Tapered.
 - C. Gypsum Board, Type X: ASTM C1396/C1396M.
 1. Thickness: 5/8 inch.
 2. Long Edges: Tapered.
 - D. Gypsum Ceiling Board: ASTM C1396/C1396M.
 1. Thickness: 1/2 inch.
 2. Long Edges: Tapered.
 - E. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 1. Core: 5/8 inch, Type X.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C1396/C1396M. Manufactured to have increased fire-resistive capability.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. American Gypsum; Firebloc Type C.
 - b. CertainTeed Corp.; ProRoc Type C.
 - c. Georgia-Pacific Gypsum LLC; Fireguard C.
 - d. Lafarge North America Inc.; Firecheck Type C.
 - e. National Gypsum Company; Gold Bond Fire-Shield C.
 - f. Temple-Inland; Type TG-C.
 - g. USG Corporation; Firecode C Core.
 2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 3. Long Edges: Tapered.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 1. Material: Paper-faced galvanized steel sheet.
 2. Shapes:
 - a. Cornerbead.

- b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
- B. Fire-Rated Sound Barrier Wall End Cap: ANSI/UL2079. UL Joint System No. WW-S-1039 for 1 hour assembly. UL Joint System No. WW-S-1041 for 2 hour assembly.
1. Basis of Design Product: "Classic 60" by Mull-It-Over, or equal.
 2. Material: Aluminum. 0.125 inches thick
 3. Rating: As indicated on Drawings.
 4. Sound Transmission: Not less than, 59 STC.
 5. Profile: As selected by Architect.
 6. Accessories: As recommended by manufacturer to form a complete system.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
1. Interior Gypsum Board: Paper.
 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- D. Joint Compound for Tile Backing Panels:
1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20 FTR.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Type X: Where required for fire-resistance-rated assembly and elsewhere as indicated on Drawings..
 - 3. Ceiling Type: Ceiling surfaces, unless noted otherwise.
 - 4. Moisture- and Mold-Resistant Type: As indicated on Drawings.
 - 5. Type C: Where required for specific fire-resistance-rated assembly indicated.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

- a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners, or as required by fire resistance rated assemblies.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners unless otherwise indicated.
 2. LC-Bead: Use at exposed panel edges.
 3. Curved-Edge Cornerbead: Use at curved openings.
- D. Install fire-rated end caps in accordance with manufacturers written recommendations.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 4. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Tile Backer Panels: Finish according to manufacturer's written instructions.
- F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain tile flooring.
2. Porcelain tile base.
3. Porcelain wall tile.
4. Stone thresholds.
5. Tile backing panels.
6. Waterproof membrane.
7. Crack isolation membrane.
8. Metal edge strips.

1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 and ANSI A137.3 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17 and ANSI A108.19, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.3 PERFORMANCE REQUIREMENTS

- A. Dynamic Coefficient of Friction: For tile installed on walkway surfaces, provide products that meet the requirements of ANSI A 137.1-2012 testing method, the DCOF AcuTest.
 1. Minimum Threshold: 0.42 for level interior spaces expected to be walked upon when wet.

1.4 ACTION SUBMITTALS

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

- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
 - 3. Full-size units of each type of trim and accessory for each color and finish required.
 - 4. Stone thresholds in 6-inch lengths.
 - 5. Metal edge strips in 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product.
- C. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Experienced firm with a record of at least five projects within the last three years successful in-service application similar in design and extent for that proposed for this project.
 - 1. Installer is a five-star member of the National Tile Contractors Association.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 or ANSI A137.3 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.10 WARRANTY

- A. Manufacturer's System Warranty: Manufacturer agrees to repair or replace tile installation that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 - 2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Waterproof membrane.
3. Crack isolation membrane.
4. Cementitious backer units.
5. Metal edge strips.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 TILE PRODUCTS (PTF-1), (PTF-2), (PTB-1), (PTW-1)

- A. Products: Subject to compliance with requirements, provide Basis-of-Design products as scheduled in the Arch – Material Finishes (Interior) Legend on the Drawings.
 1. Products: Daltile.

2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 10 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.
 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.5 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A, in maximum lengths available to minimize end-to-end butt joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C-Cure.
 - b. Custom Building Products.
 - c. Georgia-Pacific Gypsum LLC.
 - d. USG Corporation.
 2. Thickness: 5/8 inch.

2.6 WATERPROOFING AND CRACK ISOLATION MEMBRANES

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10/ANSI A118.12 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas; ARDEX S 1-K One Component Waterproofing Compound.
 - b. Custom Building Products; RedGard Waterproofing and Crack Prevention Membrane.
 - c. Laticrete International, Inc.; Laticrete Hydro Ban.
 - d. MAPEI Corporation; Mapelastic HPG.

2.7 SETTING MATERIALS

- A. Modified Dry-Set Mortar (Thinset): ANSI A118.4..
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas; X77.
 - b. Custom Building Products; Porcelain Tile.
 - c. Laticrete International, Inc.; 254 Platinum.
 - d. TEC: H.B. Fuller Construction Products Inc.; Full Flex.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- B. Large Format Tile Modified Dry-Set Mortar (Thinset): ANSI A118.4 and A118.11. .
1. Products: Subject to compliance with requirements, provide one of the following:

- a. ARDEX Americas; X5.
 - b. Custom Building Products; Pro Lite.
 - c. Laticrete International, Inc.; 4-XLT.
 - d. TEC: H.B. Fuller Construction Products Inc.; Ultimate Large Tile Mortar.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.15.

2.8 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7. **(GF-1), (GW-1)**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARDEX Americas.
 - b. Boiardi Products; a QEP company.
 - c. Bostik, Inc.; Hydroment Vivid.
 - d. Custom Building Products; Prism (Basis-of-Design).
 - e. Laticrete International Inc.; Permacolor Select.
 - f. MAPEI Corporation; Ultracolor Plus.
 - g. Summitville Tiles, Inc.
 - h. TEC: H.B. Fuller Construction Products Inc.; Power Grout.
2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
3. Color: As indicated in the Arch – Material Finishes (Interior) legend on the Drawings.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARDEX Americas; ARDEX TL 1000 Self-Leveling Underlayment.
 - b. Laticrete International, Inc.
 - c. MAPEI Corporation.
 - d. TEC: H.B. Fuller Construction Products, Inc.; Versapatch Modified Floor Patch and Leveler.

B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils thick.

C. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

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

- a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- E. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; Grout and Tile Sealer.
 - b. Laticrete International, Inc.; Bulletproof Sealer.
 - c. MAPEI Corporation; Penetrating Stone, Tile & Grout Sealer.
 - d. Summitville Tile, Inc.; SL-15 Invisible Seal.

2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone.
 - 2. Verify substrates comply with the flatness tolerances required by ANSI A108.01 and the following:
 - a. Tile with no edge larger than 15 inches; 1/4-inch in 10 feet.
 - b. Large Format Tile (15 inches or more on a side): 1/8 inch in 10 feet.
 - 3. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

- a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
4. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 5. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE BACKING PANEL INSTALLATION

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.4 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches or larger.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the joint widths the narrowest joint recommended in writing by tile manufacturer.
1. Glazed Wall Tile: 1/16 inch.
 2. Porcelain Tile: 1/16 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on approved Shop Drawings. Form full depth joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles. Provide expansion joints as follows:
1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them and of equal or greater widths.
 2. Where tilework abuts restraining surfaces such as perimeter walls, curbs, columns, and ceilings.
 3. Where there is a change in substrate material.
 4. Interior Tilework: 20 to 25 feet in each direction.
 5. Above ground concrete substrates: 8 to 12 feet in each direction.
 6. Interior tilework exposed to direct sunlight: 8 to 12 feet in each direction.
 7. Interior tilework exposed to moisture: 8 to 12 feet in each direction.
- J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set mortar (thinset).

2. Do not extend waterproofing under thresholds set in modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on waterproofing with elastomeric sealant.
- K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- L. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.5 WATERPROOFING INSTALLATION

- A. Install waterproofing at all wet areas indicated to receive tile and to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.7 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Relocated Movement Joints: Where tile joints do not align with substrate joints or existing in-plane substrate cracks, offset soft joints over crack isolation membrane in accordance with TCNA Method F125-Partial-15.
1. Minimum width of crack suppression membrane: Three times the width of tile adjacent to substrate crack or joint, such that tile on either side of joint is fully supported on membrane.
- C. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove grout residue from tile as soon as possible.
 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and

plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.8 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.9 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Ceramic Tile Installation: TCNA F113; thinset mortar.
 - a. Ceramic Tile Type: As scheduled on Drawings.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.
 - a. Ceramic Tile Type: As scheduled on Drawings.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.

END OF SECTION 093000

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SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. 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-system members.
 - 2. Method of attaching hangers to building structure.
 - 3. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 - 4. Size and location of initial access modules for acoustical panels.
 - 5. Items penetrating finished ceiling and ceiling-mounted items including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
 - 6. Minimum Drawing Scale: 1/8 inch = 1 foot.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.

2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: Class A according to ASTM E1264.
 2. Smoke-Developed Index: 50 or less.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS (ACT-1)

- A. Basis-of-Design Products: Subject to compliance with requirements, provide the Basis-of-Design indicated or a comparable product by one of the following:

1. Armstrong World Industries.
 2. CertainTeed Ceilings (Basis-of-Design).
 - a. Product: Baroque BET-157.
 3. Rockfon LLC.
 4. USG Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide fire-resistance-rated panels as follows:
1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
 2. Pattern: CD (perforated, small holes and fissured).
- D. Color: White.
- E. Light Reflectance (LR): Not less than 0.83.
- F. Ceiling Attenuation Class (CAC): Not less than 33.
- G. Noise Reduction Coefficient (NRC): Not less than 0.55.
- H. Edge/Joint Detail: Square.
- I. Thickness: 5/8 inch.
- J. Modular Size: 24 by 24 inches.
- K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.4 ACOUSTICAL PANELS (ACT-2)

- A. Basis-of-Design Products: Subject to compliance with requirements, provide the Basis-of-Design indicated or a comparable product by one of the following:
1. Armstrong World Industries.
 2. CertainTeed Ceilings (Basis-of-Design).
 - a. Product: Symphony F 1346-IOF-1.
 3. Rockfon LLC.
 4. USG Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

- C. Classification: Provide fire-resistance-rated panels as follows:
 - 1. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 2, cloth. Binder shall not contain urea formaldehyde.
 - 2. Pattern: E (lightly textured).
- D. Color: White.
- E. Light Reflectance (LR): Not less than 0.90.
- F. Noise Reduction Coefficient (NRC): Not less than 0.95.
- G. Edge/Joint Detail: Square.
- H. Thickness: 1-inch.
- I. Modular Size: 24 by 96 inches.
- J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.5 ACOUSTICAL PANELS (ACT-3)

- A. Basis-of-Design Products: Subject to compliance with requirements, provide the Basis-of-Design indicated or a comparable product by one of the following:
 - 1. Armstrong World Industries.
 - 2. CertainTeed Ceilings (Basis-of-Design).
 - a. Product: Symphony F 1358-IOF-1.
 - 3. Rockfon LLC.
 - 4. USG Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide fire-resistance-rated panels as follows:
 - 1. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 2, cloth. Binder shall not contain urea formaldehyde.
 - 2. Pattern: E (lightly textured).
- D. Color: White.
- E. Light Reflectance (LR): Not less than 0.90.
- F. Noise Reduction Coefficient (NRC): Not less than 0.95.

- G. Edge/Joint Detail: Square.
- H. Thickness: 1-inch.
- I. Modular Size: 24 by 72 inches.
- J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.6 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System (**ACT-1**): Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.
 - 1. Structural Classification: Intermediate -duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Cold-rolled steel.
 - 5. Cap Finish: Painted white.
- C. Narrow-Face, Single-Web, Extruded-Aluminum Suspension System (**ACT-2**), (**ACT-3**): Main and cross runners formed from extruded aluminum to produce structural members with 9/16-inch- wide faces.
 - 1. Structural Classification: Intermediate -duty system.
 - 2. Face Design: Screw-slot profile.
 - 3. Face Finish: Painted white.
 - 4. Reveal Finish: Match face finish.

2.7 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
- C. Hold-Down Clips: Manufacturer's standard hold-down.

2.8 METAL EDGE MOLDINGS AND TRIM

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc.
 2. CertainTeed Corporation.
 3. Fry Reglet Corporation.
 4. Gordon, Inc.
 5. Rockfon.
 6. USG Corporation.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.9 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
- B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected the ceiling plans.
 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 4. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
 - a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.
 5. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

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SECTION 095426 - SUSPENDED WOOD CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood-veneer, linear-plank ceilings.
 - 2. Wood-veneer, flat-panel ceilings.

1.2 COORDINATION

- A. Coordinate layout and installation of wood ceilings and suspension systems with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For suspended wood ceilings.
 - 1. Include reflected ceiling plans, sections, and details, drawn to scale, showing the following:
 - a. Wood ceiling patterns and joints.
 - b. Ceiling suspension members.
 - c. Method of attaching hangers to building structure and locations of cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - d. Ceiling-mounted items including, but not limited to, light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
 - e. Ceiling perimeter and penetrations through ceiling; trim and moldings.
- C. Samples for Verification: For the following products:
 - 1. Wood Ceilings: 12-inch- long by 12-inch- wide or full-width Samples of each type, color, and finish.
 - 2. Suspension-System Members: 12-inch- long Sample of each type.
 - 3. Exposed Molding and Trim: 12-inch- long Samples of each type, color, and finish.
 - 4. Veneer Edge Banding: Applied to a cut end of a wood-ceiling Sample for each type, color, and finish.
 - 5. Filler Strips: 12-inch- long Samples of each type, color, and finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Test Reports: For each suspended wood ceiling, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For suspended-wood-ceiling framing systems.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 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. Suspended-Wood-Ceiling Components: Quantity of each wood-ceiling unit, suspension-system component, accessory, and exposed molding and trim equal to 5 percent of quantity installed.

1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockup of each type of suspended wood ceiling as shown on Drawings.
 - a. Demonstrate treatment of exposed field cuts.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ceiling components and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
 - 1. Store materials flat and level, raised from the floor.

- B. Handle ceiling components and accessories in a manner that prevents damage.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install interior ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
1. Store and acclimatize wood products in the spaces where they will be installed for a minimum of 72 hours immediately before ceiling installation.

PART 2 - PRODUCTS

2.1 WOOD-VENEER, LINEAR-PLANK CEILING (WDC-2)

- A. Linear Ceiling Planks: Manufacturer's standard planks consisting of wood veneer adhered to backs and exposed surfaces of manufacturer's standard composite-wood cores; with square-cut ends.
1. Manufacturers: Subject to compliance with requirements, provide Basis-of-Design products by the following:
 - a. CertainTeed Corp., Ceilings.
 - 1) Product: 6-inch Nominal Planks (L6).
 2. Surface-Burning Characteristics: Provide products with the following characteristics when tested in accordance with ASTM E84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
 3. Veneer Face Grade: Manufacturer's standard.
 4. Veneer Species: Quartered Beech VQB0.
 5. Veneer Cut: Manufacturer's standard.
 6. Nominal Plank Width: 6 inches.
 7. Plank Depth: 3/4 inch.
 8. Plank Length: As indicated on the Reflected Ceiling Plan.
 9. Plank Long Edge: Square with tongues cut for inserting leveling splines or fillers.
 - a. Reveal/Plank Spacing: **3/4 inch** between long edges of planks.
 - b. Reveal Filler Strip: Black PVC.
 10. Plank End Joints: Butt.
 11. Veneer Adhesive: Manufacturer's standard that complies with requirements in "Performance Requirements" Article.
 12. Factory Finish: Manufacturer's standard finish; applied on every wood surface.
 - a. Type: Tinted finish in color selected by Architect from manufacturer's standard.
 - b. Stain: As selected by Architect from manufacturer's standard range.
 - c. Gloss: Manufacturer's standard.

- B. Linear-Ceiling-Plank Accessories: Linear-ceiling-plank manufacturer's accessories required to provide a complete installation of ceiling in accordance with manufacturer's written installation instructions.
1. Attachment Clips: Manufacturer's standard metal clips for attaching planks to suspension system.
 2. Plank Leveling Splines: Manufacturer's standard for aligning ends of planks.
 3. Plank Splice Plates: Manufacturer's standard.
 4. Veneer Edge Banding: Manufacturer's standard matching planks for treating cut edges; with pressure-sensitive adhesive backing.
 5. Trim: As indicated on the Drawings; with trim connectors recommended in writing by ceiling and suspension-system manufacturers.
 - a. Material: Wood-veneered composite wood, finished to match planks.
- C. Grid Suspension System: ASTM C635/C635M; recommended in writing by ceiling and suspension-system manufacturers for applications indicated; main- and cross-runner system complete with suspension-system components required to support ceiling units and other ceiling-supported construction.
1. Material: ASTM A653/A653M, hot-dip galvanized, cold-rolled sheet steel, G60 coating designation.
 2. Structural Classification: Heavy-duty system.
 3. Face Width: 15/16 inch.
 4. Finish: Flat black.

2.2 WOOD-VENEER, FLAT-PANEL CEILING (**WDC-1**)

- A. Wood Panels: Manufacturer's standard panels consisting of wood veneer bonded to both faces of composite-wood core with exposed edges banded with the same veneer finish as the face.
1. Manufacturers: Subject to compliance with requirements, provide Basis-of-Design products by the following:
 - a. CertainTeed Corp., Ceilings.
 - 1) Product: Concealed Access Panels.
 2. Surface-Burning Characteristics: Provide products with the following characteristics when tested in accordance with ASTM E84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
 3. Veneer Face Grade: Manufacturer's standard.
 4. Veneer Species: Quartered Beech VQB0.
 5. Veneer Cut: Manufacturer's standard.
 6. Panel Perforation Pattern: As indicated by manufacturers designation.
 7. Panel Surface Pattern: As indicated by manufacturers designation.
 8. Panel Module: 24 inches by length indicated on the Reflected Ceiling Plan.
 9. Panel Depth: 3/4 inch.
 10. Panel Edges: Manufacturer's standard for concealed, lay-in grid installation.

11. Veneer Adhesive: Manufacturer's standard that complies with "Performance Requirements" Article.
 12. Factory Finish: Manufacturer's standard finish; applied on every wood surface.
 - a. Type: Clear.
 - b. Stain: As selected by Architect from manufacturer's standard range.
 - c. Gloss: Manufacturer's standard.
- B. Wood-Panel Accessories: Wood-panel manufacturer's accessories required to provide a complete installation of ceiling in accordance with manufacturer's written installation instructions.
1. Attachment Clips: Manufacturer's standard screw attached to back face of panels with square-cut edges to produce concealed-grid installation and allowing downward removal of ceiling panels.
 2. Hold-Down Clips: Manufacturer's standard that maintain proper seating of kerfed panel edges.
 3. Safety Clips: Manufacturer's standard to prevent panels from dropping when disengaged from the suspension system.
 4. Safety Cables: Manufacturer's standard to prevent panels weighing 20 lb or more from falling to floor in event of grid failure.
 5. Border Clips: Manufacturer's standard spring type.
 6. Grid-Stabilizer Clips: Manufacturer's standard for oversize panels.
 7. Panel-Fixing Clip or Bracket: Manufacturer's standard that positively secures border and cut panels to the suspension system, so they cannot be removed from below.
 8. Veneer Edge Banding: Manufacturer's standard matching panels for treating cut edges; with pressure-sensitive adhesive backing.
- C. Grid Suspension System: ASTM C635/C635M; recommended in writing by ceiling and suspension-system manufacturers for applications indicated; main- and cross-runner system complete with suspension-system components required to support ceiling units and other ceiling-supported construction.
1. Material: ASTM A653/A653M, hot-dip galvanized, cold-rolled sheet steel, G60 coating designation with ASTM B209 aluminum cap.
 2. Structural Classification: Heavy-duty system.
 3. Face Width: 15/16 inch.
 4. Finish: Flat black.

2.3 SUSPENSION-SYSTEM HANGERS, BRACES, AND TIES

- A. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.
1. Power-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 hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction as determined by testing in accordance with ASTM E1190 conducted by a qualified testing and inspecting agency.

- B. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung is less than yield stress of wire, but provide not less than 0.135-inch- diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed from 0.04-inch- thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which suspended wood ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and with requirements for installation tolerances and other conditions affecting performance of suspended wood ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of suspended wood ceilings.
 - 1. Balance border widths at opposite edges of each ceiling.
 - 2. Avoid using less-than-half-width units.

3.3 INSTALLATION

- A. Comply with ASTM C636/C636M and seismic requirement indicated, in accordance with manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard

- suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns in 3 inches. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 7. Do not attach hangers to steel deck tabs.
 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns in 1-1/2 inches. Suspend bracing from building's structural members as required for hangers and without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim at perimeter of ceiling area and where necessary to conceal edges and ends of wood units.
1. Screw-attach metal moldings to substrate at intervals of not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 2. Do not use exposed fasteners on moldings and trim.
- E. Grid Suspension Systems: Space main beams at 48 inches o.c.
1. Install cross tees to form modules sized in accordance with manufacturer's written installation instructions.
 2. Remove and replace dented, bent, or kinked members.
- F. Linear-Carrier Suspension Systems: Install carriers at no more than 24 inches o.c. aligned and securely interlocked with one another.
1. Install stabilizer channels, tees, and bars at regular intervals to stabilize carriers and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated.
 2. Remove and replace dented, bent, or kinked members.
- G. Install wood components and accessories in accordance with manufacturer's written instructions and to accommodate natural expansion and contraction of wood products resulting from fluctuations in humidity.

- H. Cut wood components for accurate fit at borders and at interruptions and penetrations by other work through ceilings.
 - 1. Stiffen edges of cut wood components as required to eliminate variations in flatness.
- I. Treat field-cut edges of wood components in accordance with manufacturer's written recommendations; finish exposed field cuts to match factory finish.
 - 1. Solid-Wood Planks: Use solid-wood end caps to conceal exposed field-cut edges.
 - 2. Wood-Veneer Units: Edge band exposed field-cut edges.
- J. Install wood components in coordination with suspension system and moldings and trim.
 - 1. Install wood components in patterns indicated on Drawings.
- K. Install field-constructed access panels in locations indicated on Drawings.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented units.

END OF SECTION 095426

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermoplastic-rubber base.
 - 2. Rubber molding accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.

- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE (**RB-1**)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong Flooring.
 - 2. Flexco.
 - 3. Johnsonite, Inc.
 - 4. Nora Systems, Inc.
 - 5. Roppe Corp.
 - 6. Tarkett USA Inc. (Basis-of-Design).
- B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).
 - 1. Group: I (solid, homogeneous).
 - 2. Style and Location:
 - a. Style B, Cove: Provide in areas with resilient floor coverings.
- C. Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: As indicated in the Arch – Material Finishes (Interior) legend on the Drawings.

2.2 VINYL MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 - 3. Flexco.
 - 4. Tarkett USA.
 - 5. Roppe Corporation, USA.

- B. Description: Vinyl transition strips.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide vinyl molding accessories in areas indicated.
- E. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Metal Edge Strips: Extruded aluminum with mill finish, nominal 2 inches wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

- C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.

3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

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SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Unbacked vinyl sheet flooring.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of resilient sheet flooring.

1. Include sheet flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

C. Samples for Verification: For each type of resilient sheet flooring, in manufacturer's standard size, but not less than 6-by-9-inch sections of each color, texture, and pattern required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

D. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

E. Product Schedule: For resilient sheet flooring. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient Sheet Flooring: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring installed.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.
 1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient sheet flooring during the following periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during resilient sheet flooring installation.
- D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.

- E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 UNBACKED VINYL SHEET FLOORING (SHV-1), (SHV-2)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the Basis-of-Design indicated or a comparable product by one of the following:
 - 1. Armstrong World Industries.
 - 2. Forbo (Basis-of-Design).
 - a. Product: As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.
 - 3. Congoleum Flooring.
 - 4. Mannington Mills, Inc.
 - 5. Roppe Corporation.
- B. Product Standard: ASTM F1913.
- C. Thickness: 0.080 inch.
- D. Wearing Surface: Smooth.
- E. Sheet Width: As standard with manufacturer.
- F. Seamless-Installation Method: Heat welded.
- G. Colors and Patterns: As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

- C. Seamless-Installation Accessories:
 - 1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - a. Colors: Match flooring color.
 - 2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
- D. Integral-Flash-Cove-Base Accessories (**SHB-1**):
 - 1. Cove Strip: 1-inch radius provided or approved by resilient sheet flooring manufacturer.
 - 2. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.
- E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient sheet flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 7 or more than 10 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

- a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 90 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient sheet flooring until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 RESILIENT SHEET FLOORING INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.
- C. Lay out resilient sheet flooring as follows:
 - 1. Maintain uniformity of flooring direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
 - 3. Match edges of flooring for color shading at seams.
 - 4. Avoid cross seams.
- D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.
- H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
 2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to fuse sections permanently into a seamless flooring installation. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.
- J. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.
1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.
- B. Perform the following operations immediately after completing resilient sheet flooring installation:
1. Remove adhesive and other blemishes from surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.
1. Apply in number of coats recommended in writing by manufacturer.
- E. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 096516

SECTION 096543 - LINOLEUM FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Linoleum floor tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of linoleum flooring.

1. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

C. Samples: For each exposed product and for each color and pattern specified in manufacturer's standard size, but not less than 6-by-9-inch sections.

D. Product Schedule: For linoleum flooring. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of linoleum flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for flooring installation and seaming methods indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by flooring manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F or more than 90 deg F.
 - 1. Floor Tile: Store on flat surfaces.
 - 2. Sheet Flooring: Store rolls upright.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring during the following periods:
 - 1. 72 hours before installation.
 - 2. During installation.
 - 3. 72 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during flooring installation.
- D. Close spaces to traffic for 72 hours after flooring installation.
- E. Install flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics: For linoleum flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 LINOLEUM FLOOR TILE (RTF-1), (RTF-2), (RTF-4)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Forbo Flooring (Basis-of-Design).
 - a. Product: Marmoleum Modular.
 2. Tandus Centiva, a Tarkett company.
 3. Tate, Inc.
- B. Linoleum Floor Tile: ASTM F2195, Type I, linoleum floor tile with fibrous backing.
1. Nominal Floor Tile Size: As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.
- C. Thickness: 0.10 inch.
- D. Colors and Patterns: As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by linoleum flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by linoleum flooring manufacturer.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to linoleum flooring manufacturer's written instructions to ensure adhesion of flooring.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by linoleum flooring manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by linoleum flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 7 or more than 10 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install flooring until materials are the same temperature as space where they are to be installed.
 - 1. At least 72 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for installing flooring.
- B. Scribe and cut flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, thresholds, door frames, and nosings.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- E. Install flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.
- F. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 LINOLEUM FLOOR TILE INSTALLATION

- A. Lay out linoleum floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay floor tiles square with room axis.
- B. Match linoleum floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.
 - 1. Lay floor tiles with grain direction alternating in adjacent floor tiles (basket-weave pattern).

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting linoleum flooring.
- B. Perform the following operations immediately after completing linoleum flooring installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect linoleum flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

- D. Floor Polish: Remove soil, adhesive, and blemishes from linoleum flooring surfaces before applying liquid floor polish.
 - 1. Apply coat(s) as .
- E. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover linoleum flooring until Substantial Completion.

END OF SECTION 096543

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Primers.
 2. Water-based finish coatings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
1. Include preparation requirements and application instructions.
 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches square.
 2. Apply coats on Samples in steps to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- C. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 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. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Benjamin Moore.
 2. Scuffmaster; an ICP Building Solutions company.
 3. Sherwin-Williams Company (Basis-of-Design).
- B. Products: Subject to compliance with requirements, provide one of the products listed in the Interior Painting Schedule for the paint category indicated found at the end of Part 3.
- C. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Back-Rolling: Back roll all spray applications on walls and ceilings to allow for touch up.
- F. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Hot- and cold-water piping; fire-suppression piping.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Hot- and cold-water piping; fire-suppression piping.

3.4 WALL IDENTIFICATION

- A. Permanently label fire barriers, fire partitions, fire walls, smoke barriers, and smoke partitions with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 20 feet.
 - 2. Apply a minimum one-inch-wide bright red horizontal line, both sides of wall, interrupted for approved text, at the required interval.

3.5 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.6 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 3. Allow empty paint cans to dry before disposal.
 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board Substrates:
1. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
 - 1) Products: Subject to compliance with requirements, provide one of the following:
 - a) Benjamin Moore; Ultra Spec 500 Zero VOC Primer, N534.
 - b) PPG Paints; Speedhide Interior Latex Sealer Quick Drying, 6-2.
 - c) Sherwin-Williams; ProMar 200 Latex Primer, B28W02600.
 - b. Intermediate Coat: Matching topcoat.

-
- c. Topcoat: **(GWB-1)** Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1).
- 1) Products: Subject to compliance with requirements, provide one of the following:
- a) Benjamin Moore; Ultra Spec 500 Interior Flat Finish, N536.
- b) PPG Paints; Speedhide Zero Interior Zero-VOC Flat, 6-4110XI.
- c) Sherwin-Williams; ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series.
- d. Topcoat: **(PNT-1), (PNT-3), (PNT-4), (PNT-5)** Latex, interior, institutional low odor/VOC, eggshell (MPI Gloss Level 3).
- 1) Products: Subject to compliance with requirements, provide one of the following:
- a) Benjamin Moore; Ultra Spec 500 Interior Eggshell, N537.
- b) PPG Paints; Speedhide Zero Interior Zero-VOC Eggshell, 6-4310XI.
- c) Sherwin-Williams; ProMar 200 Zero VOC Interior Eg-Shel Latex, B20-2600 Series.
- e. Topcoat: **(PNT-2)** Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).
- 1) Products: Subject to compliance with requirements, provide one of the following:
- a) Benjamin Moore; Ultra Spec 500Interior Semi-Gloss T546/F546.
- b) PPG Paints; Advantage 900 Int/Ext Trim & Door Semi-Gloss 919-10 Series.
- c) Sherwin-Williams; Pro Industrial Acrylic Semi-Gloss Coating, B66W00651.
2. Epoxy System **(PNT-6)**:
- a. Prime Coat: Primer sealer, latex, interior.
- 1) Products: Subject to compliance with requirements, provide one of the following:
- a) Benjamin Moore; Ultra Spec 500 Zero VOC Primer, N534.
- b) PPG Paints; Speedhide Interior Latex Sealer Quick Drying, 6-2.
- c) Sherwin-Williams; ProMar 200 Latex Primer, B28W02600.
- b. Intermediate Coat: Matching topcoat.
- c. Topcoat; Interior Pre-Catalyzed Epoxy, eggshell (Gloss Level 3):
- 1) Products: Subject to compliance with requirements, provide one of the following:

- a) Benjamin Moore; Corotech Pre Catalyzed Waterborne Epoxy Eggshell, V342.
- b) PPG Paints; Pitt-Glaze WB1 Int Eggshell Pre-Catalyzed Water-borne Acrylic Epoxy, 16-310 Series.
- c) Sherwin-Williams; Pro Industrial Pre-Catalyzed Waterbased Epoxy Eg-Shel, K45W01151 Series.

B. Concrete Substrates, Traffic Surfaces:

1. Penetrating Concrete Floor Sealer (**SCN-1**): Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dayton Superior; Sure Hard Densifier J17.
 - 2) Euclid Chemical; Euro Diamond Hard.
 - 3) L & M Construction Chemicals, Inc.; Laticrete Seal Hard.
 - 4) Meadows, W.R. Inc.; Liqui-Hard.
 - 5) Sherwin-Williams; H&C Clear Liquid Hardener & Densifier.

END OF SECTION 099123

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SECTION 101100 - VISUAL DISPLAY UNITS

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

Content Requests:

[<Double click here to submit questions, comments, or suggested edits to this Section.>](#)

Access Manufacturer-Provided, AIA MasterSpec-Based Sections:

[<Double click here for this Section based on specific manufacturer's products set as Basis-of-Design at ProductMasterSpec.com.>](#)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Glass markerboards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For visual display units.
1. Include plans, elevations, sections, details, and attachment to other work.
- C. Samples: For each type of visual display unit indicated.
- D. Product Schedule: For visual display units.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS MARKERBOARDS

- A. Basis-of-Design: Subject to compliance with requirements, provide products by the Basis-of-Design indicated or comparable products by one of the following:
 - 1. Quartet; InvisaMount Glass Boards (Basis-of-Design).
 - 2. Clarus.
 - 3. Egan Visual.
 - 4. Ghent; a GMi company.
- B. Glass Markerboard Assembly: Fabricated of 6-mm tempered glass with steel backing for use with magnets.
 - 1. Edge Treatment: Smooth polished edge with eased corners.
 - 2. Surface: Glossy.
 - 3. Color: White.
- C. Mounting:
 - 1. Concealed, Z-shaped brackets.
- D. Marker Tray: Aluminum, attached with magnet.
- E. Accessories: Furnish manufacturer's dry-erase markers, eraser, and magnets.
- F. Size: 39 by 22 inches.

2.2 MATERIALS

- A. Clear Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.
- B. Extruded Aluminum: ASTM B221, Alloy 6063.

2.3 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies:
 - 1. Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

END OF SECTION 101100

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SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following types of signs:

- 1. Panel signs.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- C. Submit operation and maintenance data for installed products, including precautions against harmful cleaning materials and methods.
- D. Shop drawings showing fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.
 - 1. Provide message list for each sign required, including large-scale details of wording and lettering layout.
 - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
 - 3. Templates: Furnish full-size spacing templates for individually mounted dimensional letters and numbers.
 - 4. Furnish full-size rubbings for metal plaques.
- E. Samples: Provide samples of each sign component for verification of compliance with requirements indicated.

1.4 QUALITY ASSURANCE

- A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.
- B. Accessibility Requirements: Comply with ADA Accessibility Guidelines. Machine-cut copy characters from opaque acrylic sheet and chemically weld onto the acrylic sign panel face or use photopolymer process to produce raised copy and Braille tags. Produce precisely formed characters with square cut edges free from burrs and cut marks.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Panel Sign: Subject to compliance with requirements, provide products as scheduled by one of the following:
 - 1. Andco Industries Corp.
 - 2. APCO Graphics, Inc.
 - 3. ASI Sign Systems, Inc.
 - 4. Best Manufacturing Company.
 - 5. Gemini, Inc.
 - 6. Matthews International Corp.
 - 7. Metallic Arts, Inc.
 - 8. Mohawk Sign Systems.
 - 9. Spanjer Brothers, Inc.
 - 10. The Supersine Company.
 - 11. Vomar Products, Inc.
 - 12. Signage Industries.

2.2 MATERIALS

- A. Plastic Laminate: Provide high-pressure laminate engraving stock with face and core plies as selected by Architect from manufacturer's full range.
- B. Aluminum Sheet: Provide aluminum sheet of alloy and temper recommended by the sign manufacturer for the type of use and finish indicated, and with not less than the strength and durability properties specified in ASTM B 209 for 5005-H15.

- C. Aluminum Extrusions: Provide aluminum extrusions of alloy and temper recommended by the sign manufacturer for the type of use and finish indicated, and with not less than the strength and durability properties specified in ASTM B 221 for 6063-T5.
- D. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by the sign manufacturer for the casting process used and for the use and finish indicated.
- E. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.
- F. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.3 PANEL SIGNS

- A. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to comply with the following requirements:
 - 1. Edge Condition: Square cut.
 - 2. Corner Condition: Square.
- B. Graphic Content and Style: Provide sign copy that complies with the requirements as selected by Architect for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.
 - 1. Character Style: Times New Roman.
- C. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
 - 1. Raised-Copy Thickness: Not less than 1/32 inch.
- D. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of slide-in inserts 2 inches in height without requiring sign disassembly.
 - 1. Locations: For room names of offices and classrooms (not for room numbers).
 - 2. Furnish insert material and software for creating text and symbols for PC-Windows and Macintosh computers for Owner production of paper inserts.
 - 3. Furnish insert material cut-to-size for changeable message insert.

2.4 FINISHES

- A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide colors as selected by the Architect from the manufacturer's full range.

- B. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations.
- C. Aluminum Finishes: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
 - 1. Baked-Enamel Finish: AA-M4xC12C42R1x (Mechanical Finish: Manufacturer's standard, other nondirectional textured; Chemical Finish: Chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.
 - a. Organic Coating: Thermosetting-modified acrylic enamel primer/topcoat system complying with AAMA 603.8 except with a minimum dry film thickness of 1.5 mils, medium gloss.
 - b. Color: Dark Oxide.
- D. Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over a polished (directionally textured), mechanical finish, complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
- B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:
 - 1. Silicone-Adhesive Mounting: Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended by the sign manufacturer to hold the sign in place until the adhesive has fully cured.

3.2 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION 101400

SECTION 102123 - CUBICLE CURTAINS AND TRACK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Curtain tracks and carriers.
 2. Cubicle curtains.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include durability, laundry temperature limits, fade resistance, applied curtain treatment, and fire-test-response characteristics for each type of curtain fabric indicated.
 2. Include data for each type of track.
- B. Shop Drawings: Show layout, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
- C. Samples: For each type of product required, prepared on Samples of size indicated below:
1. Curtain Fabric: 10-inch square swatch or larger as required to show complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
 2. Mesh Top: Not less than 10 inches square.
 3. Curtain Track: Not less than 10 inches long.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
1. Ceiling suspension assembly members.
 2. Method of attaching track hangers to building structure.
 3. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For curtains, track, and hardware to include in operation and maintenance manuals.

1.5 PERFORMANCE REQUIREMENTS

- A. Curtains: Provide curtain fabrics with the following characteristics:
1. Launderable to a temperature of not less than 160 deg F.

2. Flame resistant and identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install cubicle curtains and tracks until wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where cubicle curtains are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 1. AR Nelson Company
 2. C/S General Cubicle
 3. Imperial Fastener Company, Inc.
 4. InPro Corporation

2.2 CURTAIN SUPPORT SYSTEMS

- A. Extruded-Aluminum Curtain Track: Not less than 1-1/4 inch wide by 3/4 inch high; with 0.062-inch minimum wall thickness.
 1. Curved Track: Factory-fabricated, 12-inch radius bends.
 2. Finish: Baked enamel, acrylic, or epoxy.
- B. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
- C. Curtain Carriers: Two nylon rollers and nylon axle with chrome-plated steel or aluminum hook.
- D. Fasteners: Stainless steel.

2.3 CURTAINS (PRC-1)

- A. Curtain Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.
 1. Pattern and Color: As indicated on Finish Legend or an Architect approved comparable product.

- B. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.
- C. Mesh Top: Not less than 20-inch high nylon mesh top.

2.4 CURTAIN FABRICATION

- A. Fabricate curtains as follows:
 - 1. Width: Equal to track length from which curtain is hung plus 10 percent added fullness, but not less than 12 inches added fullness.
 - 2. Length: Equal to floor-to-ceiling height minus 20 inches from finished ceiling at top, and minus 12 inches above finished floor at bottom.
 - 3. Mesh Top: Top hem of mesh not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double lockstitched. Double lockstitch bottom of mesh directly to 1/2-inch triple thickness, top hem of curtain fabric.
 - 4. Bottom Hem: Not less than 1 inch and not more than 1-1/2 inches wide, double thickness and single lockstitched.
 - 5. Side Hems: Not less than 1/2 inch and not more than 1-1/4 inches wide, with double turned edges, and single lockstitched.
 - 6. Vertical Seams: Not less than 1/2 inch wide, double turned and double stitched.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install tracks level and plumb, according to manufacturer's written instructions.
- B. Up to 20 feet in length, provide surface-mounted curtain track fabricated from single, continuous length.
- C. Surface-Track Mounting: Fasten tracks to ceilings at intervals recommended by manufacturer. Fasten tracks to structure at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to suspended ceiling grid with manufacturer's proprietary clip.
- D. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.
- E. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along full length of curtain plus an additional carrier.

- F. Curtains: Hang curtains on each curtain track.

END OF SECTION 102123

SECTION 102600 -WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Corner guards.
 2. Abuse-resistant wall coverings.

1.2 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.
1. For adhesives, documentation including printed statement of VOC content.
- B. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
1. Corner Guards: 12 inches long. Include examples of joinery, corners, and field splices.
 2. Wall Guards: 12 inches long. Include examples of joinery, corners, end caps, top caps, and field splices.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each impact-resistant plastic material, from manufacturer.
- B. Material Test Reports: For each impact-resistant plastic material.
- C. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.
1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Section 014000 "Quality Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.
- E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- F. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the Basis-of-Design product indicated or a comparable product by one of the following:
1. Construction Specialties, Inc. (C/S Group).
 2. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 3. J.L. Industries; an Activar Construction Products Group company.
 4. Koroseal Interior Products, LLC. (Basis-of-Design).
 5. Pawling Corporation.

2.2 MATERIALS

- A. PVC Plastic: ASTM D1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; sheet material, thickness as indicated.
1. Impact Resistance: Minimum 25.4 ft-lbf/in. of notch when tested according to ASTM D256, Test Method A.
 2. Chemical and Stain Resistance: Tested according to ASTM D543 or ASTM D1308.
 3. Self-extinguishing when tested according to ASTM D635.
 4. Flame-Spread Index: 25 or less.
 5. Smoke-Developed Index: 450 or less.
- B. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated but with not less than strength and durability properties specified in ASTM B221 for Alloy 6063-T5.
- C. Stainless-Steel Sheet: ASTM A240/A240M.
- D. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- E. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.
1. Use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Gypsum Board and Panel Adhesives: 50 g/L.
 - b. Multipurpose Construction Adhesives: 70 g/L.
 - c. Contact Adhesive: 250 g/L.

2.3 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards **(CG-4)**: Fabricated from one-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
1. Basis-of-Design: Inpro Door and Wall Protection Systems.
 2. Material: Aluminum.
 - a. Profile: As indicated by manufacturers designation.
 - b. Height: Full height of wall.
 - c. Attachment: #535 Heavy duty adhesive.
 - d. Color and Texture: Clear anodized finish. Finish shall be to 204R1 specification.
 3. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.
- B. Surface-Mounted, Rigid Sheet Trim **((CG-1), (CG-2), (CG-3))**: Assembly consisting of snap-on plastic cover installed over continuous retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
1. Basis-of-Design: Koroseal.
 - a. Product: Korogard G100.
 2. Cover:
 - a. Profile: As indicated by manufacturers designation.
 - b. Height: 48 inches.
 - c. Color and Texture: As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.

2.4 IMPACT-RESISTANT WALL COVERINGS

- A. Impact-Resistant Sheet Wall Covering **(WP-1), (WP-2), (WP-3)**: Fabricated from semirigid, plastic sheet wall-covering material.
1. Basis of Design Products: Koroseal.
 - a. Products: Korogard Sheets.
 2. .
 3. Size: 48 by 120 inches for sheet.
 4. Sheet Thickness: 0.040 inch.
 5. Color and Texture: As Scheduled.
 6. Sheet Size: 48 by 120 inches.
 7. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
 8. Mounting: Adhesive.
 9. Color: As indicated in the Arch – Material Finishes (Interior) legend on the Drawings.

2.5 FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.
- C. Prime gypsum wallboard scheduled to receive impact resistant wall covering in accordance with manufacturer's written instructions.

3.3 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 - 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.

2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Provide anchoring devices to withstand imposed loads.
 - b. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102800 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Healthcare accessories.

1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

- A. Product Data Submittals: For each product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Include electrical characteristics.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, visible silver spoilage defects.
 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide the Basis-of-Design products indicated by one of the following, unless otherwise indicated:
1. Bobrick Washroom Equipment.
 2. Bradley Corporation.
 3. GP Professional (GP Pro).
 4. ULINE.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Design accessories and fasteners to comply with the following requirements:
1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

- A. Toilet Tissue (Jumbo-Roll) Dispenser (**TP**):
1. Basis-of-Design Product: Bradley; Model 5426-1195; Jumbo Dual Roll Toilet Paper Dispenser.
 2. Description: Two-roll unit.
 3. Mounting: Surface mounted.
 4. Capacity: Up to 9-inch- diameter rolls.
 5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 6. Lockset: Tumbler type.
 7. Refill Indicator: Pierced slots at front.
- B. Soap Dispenser (**SD**):
1. Owner-Furnished / Contractor-Installed.
- C. Grab Bar (**GB2**), (**GB3**), (**GB5**):
1. Basis-of-Design Product: Bradley; Model 812 Series Stainless Steel Grab Bars with Concealed Flange.

2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin).
4. Outside Diameter: 1-1/4 inches.
5. Configuration and Length: As indicated on Drawings.

D. Grab Bar (**GB6**)

1. Basis-of-Design Product: Bradley; Model 8370-107; Swing-Up Grab Bar
2. Mounting: Install with Bradley Mounting Kit.
3. Material:
 - a. Tubing: 1-1/4-inch O.D. 18-gauge stainless steel, seamless construction with exposed surfaces in architectural satin finish. All welds ground and polished to blend.
 - b. Wall Plate: 12-gauge stainless steel with exposed surfaces in architectural satin finish. Concealed mechanism holds bar up and out of the way.
4. Installation: Verify all rough-in dimensions prior to installation. Secure to wall where adequate in-wall backing exists. Use bar as template to locate mounting holes. Drill holes and set anchors as appropriate. Mount grab bar and secure mounting screws. (For Bradley grab bar mounting kits, visit bradleycorp.com.) Mark point of contact with wall when bar is in raised position. Secure bumper to wall with screw at this point.

E. Sanitary-Napkin Disposal Unit (**ND1**):

1. Owner-Furnished / Contractor Installed.

F. Mirror Unit (**MIR-1**), (**MIR-2**):

1. Basis-of-Design Product: Bradley; Model 780 Mirror with Stainless Steel Angle Frame.
2. Frame: Stainless steel angle, 0.05 inch thick.
 - a. Corners: Mitered and mechanically interlocked.
3. Size:
 - a. (**MIR-1**): 18 by 36 inches.
 - b. (**MIR-2**): 24 by 60 inches.
4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

G. Hook:

1. Basis-of-Design Product: Franklin Brass Coat and Hat Hook; Model #B59303G-SN-C available on Amazon.com.
2. Description: Combination hat and coat hook.
3. Mounting: Exposed.
4. Material and Finish: Satin nickel-plated brass.

2.4 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Shower Curtain Rod (**RAIL**):

1. Basis-of-Design Product: Bradley; Model 9539;
2. Description: 1-1/4-inch- outside diameter, straight rod.
3. Configuration: As indicated on Drawings
4. Mounting Flanges: Concealed fasteners; in material and finish matching rod.
5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

B. Robe Hook (**HK**):

1. Basis-of-Design Product: Bradley; Model 9124; Stainless Steel Double Robe Hook
2. Description: Double -prong unit.
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.5 HEALTHCARE ACCESSORIES

A. Source Limitations: Obtain healthcare accessories from single source from single manufacturer.

B. Specimen Pass-Through Cabinet:

1. Basis-of-Design Product: Bradley; Model #9813 Recessed Specimen Pass-Through Cabinet.
2. Description: Two-sided type, with self-closing, interlocking doors on both sides, that prevent both from being open at same time, and removable stainless steel tray.
3. Nominal Wall Opening: 11-3/8 by 10-5/8 inches, width by height.
4. Doors: 20-gauge Stainless-steel with exposed surfaces in architectural satin finish. Equipped with full-length stainless steel piano spring hinge and chrome plated brass pull knob. Doors are self-closing.
5. Material and Finish: 18-gauge Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.6 CUSTODIAL ACCESSORIES

A. Custodial Mop and Broom Holder (**MHI**):

1. Basis-of-Design Product: Bradley; Model 9953 BradEX; Mop and Broom Holder
2. Description: Unit with rubber cam holders.
3. Length: 24 inches.
4. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.7 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- minimum nominal thickness.

- C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- F. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.8 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
 - 1. Remove temporary labels and protective coatings.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

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SECTION 104400 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Portable fire extinguishers.
 - 2. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.
 - 3. Fire-protection accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.4 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Fire Extinguishers and Cabinets:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. J.L. Industries, Inc.
 - e. Larsen's Manufacturing Company.
 - f. Potter-Roemer; Div. of Smith Industries, Inc.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 1. Sheet: ASTM B209.
 2. Extruded Shapes: ASTM B221.
- B. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).
- C. Valves: Manufacturer's standard.
- D. Handles and Levers: Manufacturer's standard.
- E. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

2.3 PORTABLE FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

- B. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb nominal capacity, in enameled-steel container.

2.4 FIRE PROTECTION CABINET (**FEC**)

- A. Cabinet Construction: Nonrated.
- B. Cabinet Material: Aluminum sheet.
- C. Shelf: Same metal and finish as cabinet.
- D. Fully Recessed Cabinet: Cabinet box fully recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.
- E. Cabinet Trim Material: Aluminum sheet.
- F. Door Material: Aluminum sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting lever handle with cam-action latch.
 - 2. Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 - 3. Provide manufacturer's standard hinge permitting door to open 180 degrees.
- J. Number Plate: 3-layer laminated plastic plate with black letters on white background. Confirm numbering system with Owner.
- K. Finishes:
 - 1. Aluminum: Clear anodic.

2.5 MOUNTING BRACKETS

- A. Mounting Brackets (**FEB**): Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.

- b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - f. Larsen's Manufacturing Company.
 - g. Potter Roemer LLC.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
- 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

2.6 ACCESSORIES

- A. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
- 1. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER" applied to cabinet door or reverse applied to interior of door glazing.
 - a. Application Process: Silk Screened 3/4 by 18 inches.
 - b. Lettering Color: Red.
 - c. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where fully recessed cabinets are to be installed.
- B. Examine fire extinguishers for proper sizing, charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing fire-protection specialties.

- B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
 - 1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
 - 2. Fasten mounting brackets to structure and cabinets, square and plumb.
 - 3. Fasten cabinets to structure, square and plumb.
- C. Install number plate on each fire extinguisher cabinet and on wall beside fire extinguisher bracket.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust cabinet doors that do not swing or operate freely.
- B. Refinish or replace cabinets and doors damaged during installation.
- C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 104400

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SECTION 105613 - METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Post-and-beam metal storage shelving.

1.2 COORDINATION

- A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.
- B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For metal storage shelving.
 1. Include plans, elevations, sections, and attachment details.
 2. Include installation details of connectors, lateral bracing, and special bracing.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 POST-AND-BEAM METAL STORAGE SHELVING

- A. Post-and-Beam Metal Shelving: Complying with MH 28.2; field-assembled from factory-formed components. Shelves are supported by beams that span between supporting corner posts that allow beam-height adjustment over full height of shelving unit. Provide fixed top and bottom beams, adjustable intermediate beams, and accessories indicated.
 1. Basis-of-Design: Subject to compliance with requirements, provide the following:
 - a. ULINE; Chrome Wire Shelving.

- 1) Product: Model Nos. H-2940-72 and H-2941-72.
- B. Load-Carrying Capacity per Shelf: 800 lb, uniformly distributed.
- C. Posts: Fabricated from cold-rolled steel; in manufacturer's standard shape; with perforations at 1-1/2 inches o.c. to receive beam-to-post connectors.
 1. Unit Configuration: Configure shelving units as starter- and add-on unit assemblies.
 2. Post Base: Cold-rolled steel floor plate, drilled for floor anchors.
- D. Beams: Fabricated from cold-rolled steel; in manufacturer's standard shape. Provide beam at each side of each shelf, with center supports as required for load-carrying capacity of shelf.
 1. Beam-to-Post Connectors: Projecting manufacturer's standard at each end that engage posts.
 - a. Top and Bottom Shelf Beams: Provide with single beam-to-post connectors.
 - b. Intermediate Shelf Beams: Provide with single beam-to-post connectors.
 2. Beam Quantity: As required for number of shelves indicated per shelving unit.
- E. Wire Shelves: Welded steel wire; with Manufacturer's standard openings.
- F. Accessories:
 1. Tie Plates: Cold-rolled steel, finished to match posts; designed for joining posts of adjacent shelving units.
 2. Supports: Back-to-wall and back-to-back type that bolt to posts; as required for shelving unit stability.
- G. Steel Finish: Baked enamel or powder coat.
 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.
 1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
 3. Connect side-to-side and back-to-back shelving units together.
 4. Install shelves in each shelving unit at spacing indicated on Drawings.
 - a. Post-and-Beam Metal Storage Shelving: Install beams with beam-to-post connectors fully engaged in post perforations.

3.2 ERECTION TOLERANCES

- A. Erect post-and-beam metal storage shelving to a maximum tolerance from vertical of 1/4 inch in 84 inches of height.

3.3 ADJUSTING

- A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.
- B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.
- C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.
- D. Replace metal storage shelving components that have been damaged beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 105613

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SECTION 113100 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Cooking appliances.
 2. Refrigeration appliances.
 3. Cleaning appliances.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.
- B. Appliance Schedule: For appliances; use same designations indicated on Drawings.
- C. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.
- D. Maintenance Data: For each product to include in maintenance manuals.
- E. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for product's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- D. Regulatory Requirements: Comply with provisions of the following product certifications:
1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
 3. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
 4. NAECA: Provide residential appliances that comply with NAECA standards.
- E. Regulatory Requirements, Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with ANSI A117.1.
1. Operable Parts: Provide controls with forward reach no higher than 48 inches above the floor, horizontal front reach no more than 25 inches, horizontal side reach no more than 24 inches, and that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

PART 2 - PRODUCTS

2.1 APPLIANCES

- A. Appliances shall be Owner furnish/Contractor Installed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written instructions.
- B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- C. Utilities: Refer to Divisions 22 and 26 for plumbing and electrical requirements.

3.3 CLEANING AND PROTECTION

- A. Test each item of residential appliances to verify proper operation. Make necessary adjustments.
- B. Verify that accessories required have been furnished and installed.

- C. Remove packing material from residential appliances and leave units in clean condition, ready for operation.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 113100

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SECTION 117000 - MEDICAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Coordination of Installation of Owner-furnished, Vendor-Installed medical equipment.
2. Installation of Owner-furnished, Contractor-installed medical equipment.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to medical equipment including, but not limited to, the following:

1. Review structural load limitations.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required certifying procedures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of components. Indicate location and size of each field connection.
3. Include diagrams for service connections and power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long in size.

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

1. Include Samples of accessories to verify color and finish selection.

E. Product Schedule: For medical equipment. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For above-ceiling supplementary framing for support and anchorage of medical equipment, signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For products to include in operation and maintenance manuals.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install medical equipment until spaces are enclosed and weathertight and wet work in spaces is complete and dry.
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with field measurements before installation.

1.6 COORDINATION

- A. Coordinate installation of medical equipment with laboratory casework, mechanical, plumbing and electrical work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design above-ceiling supplementary framing for support and medical equipment.

2.2 OWNER-FURNISHED MEDICAL EQUIPMENT

- A. Refer to Medical Equipment Matrix included in the specification Appendix to identify responsibility for installation of medical equipment furnished by Owner.
- B. The Work includes providing support systems to receive Owner's equipment and service connections.
 - 1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
 - 2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
 - 3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
 - 4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
 - 5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
 - 6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.

7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.

2.3 MEDICAL EQUIPMENT DRAWINGS AND CUTSHEETS

- A. Specifications and prototype drawings for this Project, prepared by the manufacturer and installation instructions are available for viewing as follows and appended to this Document.
 1. Appendix A: Shielding Plan Review Form.
 2. Appendix B: Diagnostic X-Ray Room Shielding Design Report: 11-1-2023.
 3. Appendix C: Injector System Site Survey and Site Installation Instructions.
 4. Appendix D: Equipment Coordination Drawing.
 5. Appendix E: Diagnostic X-Ray Room Shielding Design Report: 10-03-2023.
 6. Appendix F: Architectural Equipment Plan.
 7. Appendix G: Radiation Shielding Design Verification.
 8. Appendix H: Site Planning Guide: Carestream DRX-1 Radiographic System.
 9. Appendix I: CleanSeam Pass-Through Chamber.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Provide blocking and support for medical equipment.
- B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF MEDICAL EQUIPMENT

- A. General: Install medical equipment in strict accordance with manufacturer's written instructions and approved Shop Drawings.
- B. Refer to Division 26 Sections for requirements such as electrical connections, grounding, and bonding.

3.3 ADJUSTING

- A. Adjust products for proper function and operation to comply with manufacturer's written instructions.

3.4 PROTECTION

- A. Protect installed products from damage for the remainder of the construction period.
- B. Repair damaged products according to manufacturer's written instructions. If damaged products cannot be successfully repaired, as determined by Architect, remove and replace damaged products.

END OF SECTION 117000



North Carolina Department of Health and Human Services
 Division of Health Service Regulation
RADIATION PROTECTION SECTION
Radiology Compliance Branch

SHIELDING PLAN REVIEW FORM

Shielding Plan Preparer Information:

Date:

[Shielding Plan Review Mailbox](#)

Company Name		Address	
Registration #	Phone Number	Submitter Name	Email Address

Facility Information: †Please select facility status: Initial (never registered) Existing (currently registered) Relocation (existing facility moving to a new location)

Facility Name		Registration #	Facility Status†	
Current Physical Address of Facility		City	State	Zip
New Address if Relocating Facility		City	State	Zip
Mailing Address of Contact		City	State	Zip
Contact Name	Phone Number		Email Address	

Remarks:

Equipment Information:

*Select Equipment Status: **R** (Replacement) **RL** (Relocation of existing unit) **N** (First time equipment installed in this location/ room)

** Select Facility Type: **M** (Medical & Dental extra-oral) **D** (Dental intraoral & Panorex) **V** (Veterinary)

Room #’s	Manufacturer	*Equipment Status	kVp	mA	mA*min /week	**Facility Type	Proposed Date of Installation

RPS USE ONLY

Plan Number		Name/ Address on each page of shielding plan	<input type="checkbox"/>	Reviewer	
Submitted Date		Barriers Identified (primary & secondary)	<input type="checkbox"/>	Acknowledged	<input type="checkbox"/>
Ready for Review Date		Construction Material Identified	<input type="checkbox"/>	Denied	<input type="checkbox"/>
Drawings Legible	<input type="checkbox"/>	Scale Identified/ correct	<input type="checkbox"/>	Date Letter Mailed	
Preparer Registered	<input type="checkbox"/>	Location of doors, windows, mirrors, image receptor, exposure switch and x-ray tube	<input type="checkbox"/>	Application Mailed	<input type="checkbox"/>
				NOR Mailed	<input type="checkbox"/> File <input type="checkbox"/>

Remarks:



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November 1, 2023

Shannon Jackson, Medical Imaging Manager
Cancer Center at Central Harnett
225 Brightwater Dr.
Lillington, NC 27546
Email: sjackson52dbb@capefearvalley.com

RE: DIAGNOSTIC X-RAY ROOM SHIELDING DESIGN REPORT

Dear Ms. Jackson,

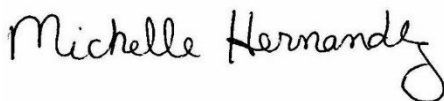
Enclosed please find the revised shielding design report for the **Siemens Somatom go.Open Pro** at the above address.

- **Please review the report carefully to ensure all submitted information was correctly interpreted and to notify us of any revisions that need to be addressed.**
- We have filed a copy of the report with the North Carolina Department of Health and Human Services, Radiation Protection Section, on your behalf and you should receive correspondence from that agency shortly regarding approval and registration.
- Landauer's recommendations are based upon the state regulations: *North Carolina Administrative Code, Title 10A, Chapter 15*
- The state regulations are available for review on the following website address: <https://radiation.ncdhhs.gov>
- Retain a copy of the report to document the calculated shielding required to meet dose limits prescribed in 10A NCAC 15 .1604 & .1611.
- **10A NCAC 15 .1603 requires facilities to develop, document, and implement a Radiation Protection Program.**

If you would like assistance with **post-installation radiation survey requirements** and/or with developing a **site-specific Radiation Protection Program**, please request a quote by contacting our team of Shield Design Coordinators at 1.888.831.4880 Option 3 or by emailing them at shieldingdesign@landauermp.com. They are also available to answer any other questions you may have with this Shield Design Report.

Thank you for choosing Landauer Medical Physics as your radiation protection service provider.

Sincerely,



Michelle Hernandez, M.S.
Medical Physicist
LANDAUER Medical Physics

"LANDAUER is here to help you as your resource for radiation safety services!!"

PLAN REVIEW SHIELDING REPORT

Calculation Parameters – Siemens Somatom go.Open Pro

Imaging Type	Workload (mA-min/week)	kVp
Computerized Tomography	18,000	140

Shielding Recommendations:

Wall Section	Protected Area	Type	LMP Recommended Shielding (See Note 1)
A-B	Control	SC	1/16" Lead Wall and 1/16" Lead Equivalent Glass
B-C	Corridor	SU	1/16" Lead Door
C-D	Restroom/Dressing	SU	1/16" Lead Wall
D-E	Equip Rm	SU	1/16" Lead Wall
E-F	Storage	SU	1/16" Lead Wall
F-G	Exterior	SU	1/16" Lead Wall
G-A	Corridor	SU	1/16" Lead Wall
Ceiling	Multiuse	SU	1/16" Lead Center Above CT
Floor	Slab on Grade	SU	None; Nothing Below.

P = primary barrier; S = secondary barrier; C = controlled area; U = uncontrolled area; OF = occupancy factor

Additional Variables & Calculated Transmission Factor

Wall Section	Distance (m)	P _{Design Goal} (mR/wk)	Occupancy Factor T	K _{sec} (0) (mR/wk)	* Transmission Factor B(x) _{barrier}
A-B	5.58	10	1	510.84	0.020
B-C	5.86	2	0.2	92.42	0.022
C-D	3.62	2	0.05	42.83	0.047
D-E	3.29	2	0.025	25.88	0.077
E-F	3.29	2	0.05	19.13	0.105
F-G	2.86	2	0.025	50.12	0.040
G-A	2.87	2	0.2	278.68	0.007
Ceiling	2.13	2	1	2619.61	0.001
Floor	N/A	N/A	N/A	N/A	N/A

Design dose limits: Uncontrolled - 2 mrem/week (100 mrem/year); Controlled - 10 mrem/week (500 mrem/year)

* NCRP 147 Transmission Factor, B(x):

$$B_{sec}(X) = (P/T) * d_{sec}^2 / (K_{sec}^1 * N) = (P/T) / K_{sec}(0)$$

GLOBAL PHYSICS SOLUTIONS DBA

LANDAUER[®]
MEDICAL PHYSICS

Definition of Terms

N_{weekly} – number of patients per week

K_{sec(0)} – total weekly unattenuated air kerma at point of interest from source for all patient exposures

Distance – total distance from scatter object to the area of concern (distance to wall plus 1 foot) for secondary scatter; primary beam distance is the distance from the tube to the area of concern (distance to wall plus 1 foot)

T – Occupancy factor (hours per week a person spends in the protected area)

P_{week} – Design Goal or exposure limit per week

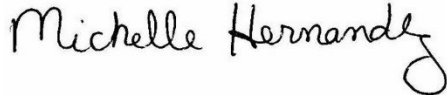
B(x) – radiation transmission through a given barrier material (x)

Table Notes and Additional Information

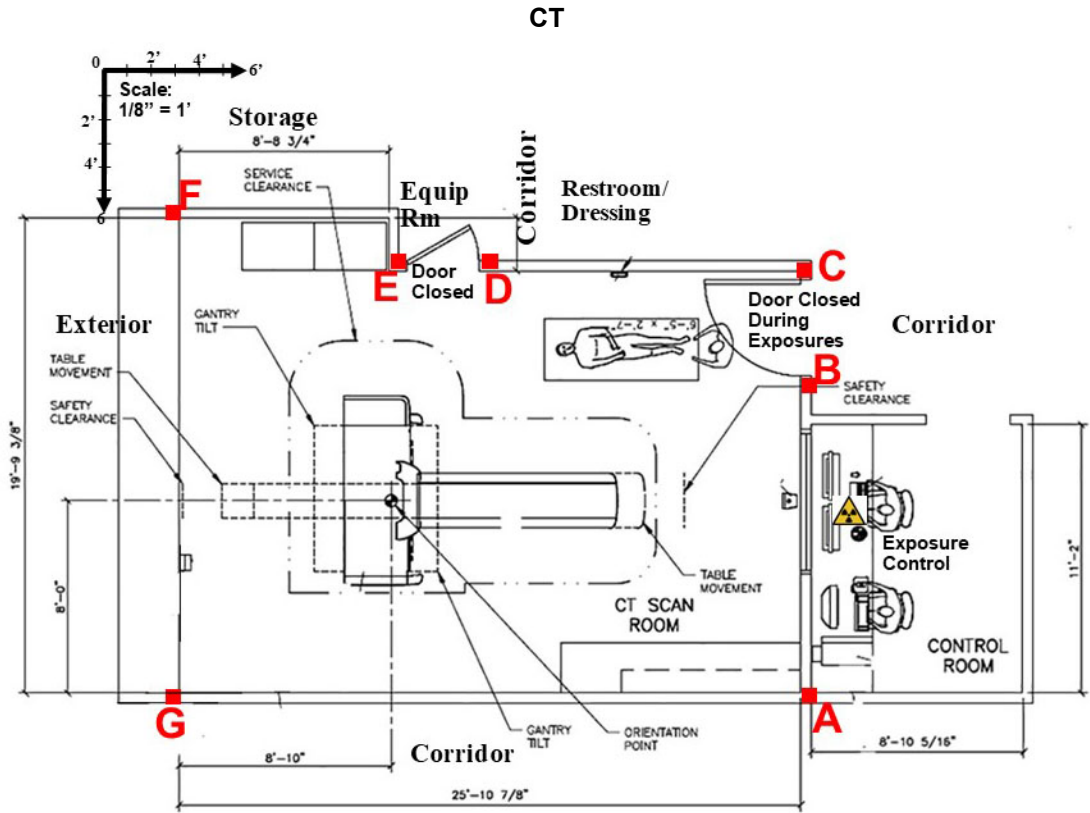
- **IMPORTANT** - This plan review is specific for the information provided by the requestor. Any changes in equipment, room layout, occupancy of adjacent areas, changes in x-ray workload, upgrades to additional imaging modalities, changes in field size of imaging receptors, or any other condition that may contribute to an increased risk of radiation exposure will require re-evaluation of the shielding by a qualified physicist. If there are any doubts about what may constitute a change, please contact LANDAUER Medical Physics.
- **Note 1** - Areas beyond the immediate adjacent space to the barrier of interest have been considered when determining shielding recommendation.
- The recommended shielding is the total thickness of specified material needed to reduce the radiation dose below regulatory limitations.
- Prior to construction of all new installations, or modifications of existing installations, or installation of equipment into existing facilities utilizing X-rays for diagnostic or therapeutic purposes, the floor plans and equipment arrangements shall be submitted to the agency for review and verification that national standards have been met.
- *Regulatory Note: Regulatory Note: For stationary x-ray systems, the control shall be permanently mounted in a protected area so that the operator is required to remain in that protected area during the entire exposure. {NC Administrative Code 10A 15.0606(b)(2)(B)(1)}*
- **Doors to room closed during x-ray production.**
- **Wall shielding must extend from the finished floor to a height of 84”.**
- All shielded barriers, including view windows and frames, doors and door frames, should be of the specified shielding equivalencies or greater and should have no voids.
- Any penetrations in the shielding should be designed to afford the same shielding equivalency as specified for that barrier.
- Penetrations in the shielding (electrical boxes, cables, fasteners, etc.) should be secured in place with mechanical fasteners or by welding. Metal screws do not require lead caps and the use of tapes, adhesives or plastic materials as a fastener is not recommended.

- Landauer Medical Physics performs transmission calculations based on the information provided by the requestor's Shield Design application and cannot be held responsible for errors in shielding requirements due to inaccurate information.
- These shielding specifications have been prepared in accordance with guidelines set forth in National Council on Radiation Protection and Measurements Report 147, and NC Administrative Code.
- The state agency reserves the right to impose additional requirements, as it deems appropriate or necessary to minimize danger to public health, safety or property.

Shielding Calculations Submitted by:



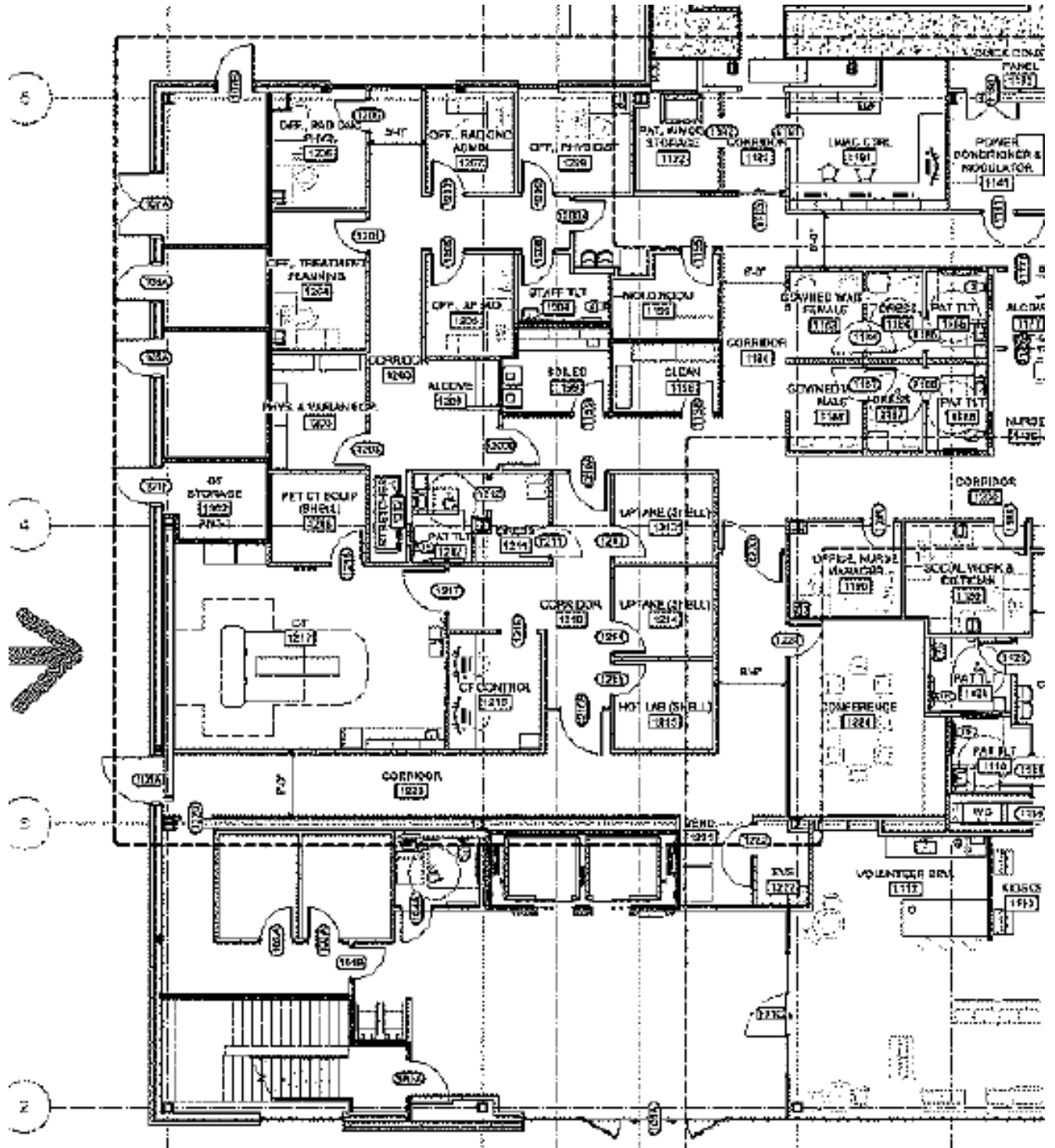
Michelle Hernandez, M.S.
Medical Physicist



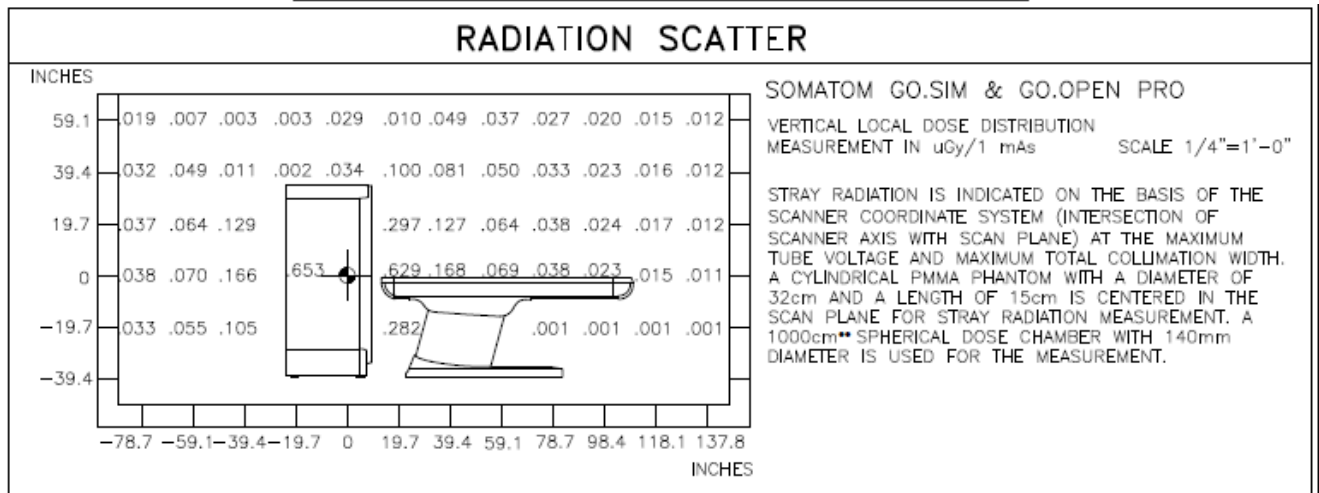
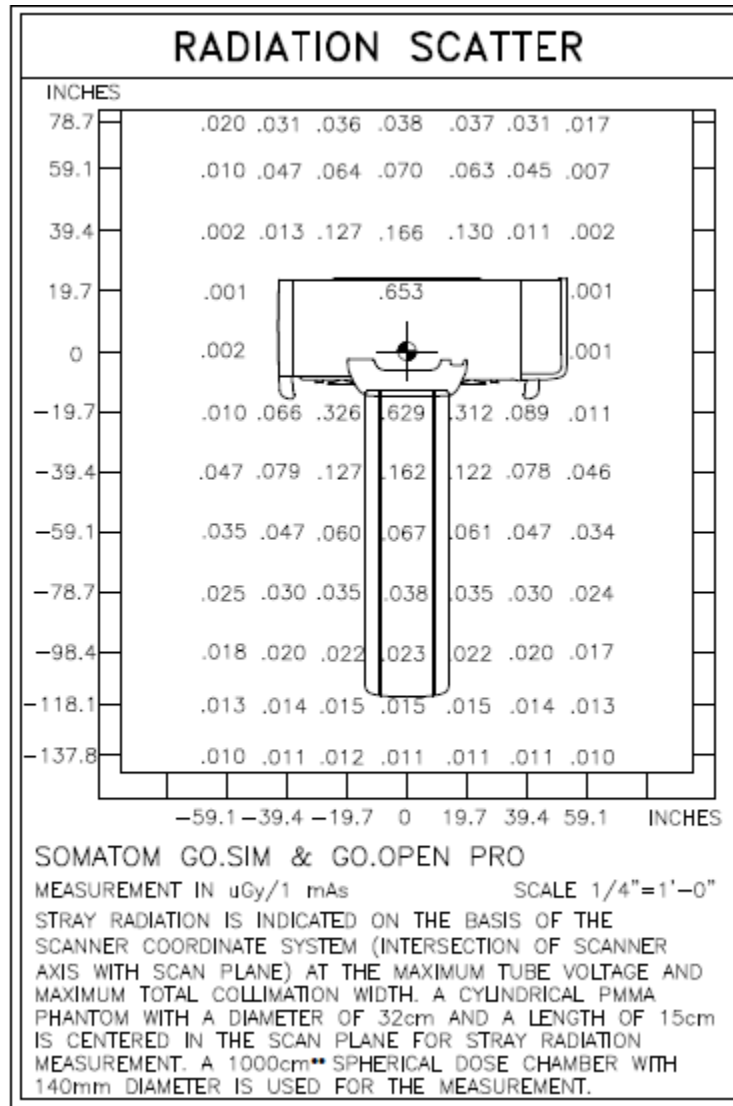
Shielding Recommendations:

Wall Section	Barrier Type	LMP Recommended Shielding
A-B (Control)	Wall/Window	1/16" Lead Wall and 1/16" Lead Equivalent Glass
B-C (Corridor)	Door	1/16" Lead Door
C-D (Restroom/Dressing)	Wall	1/16" Lead Wall
D-E (Equip Rm)	Door	1/16" Lead Wall
E-F (Storage)	Wall	1/16" Lead Wall
F-G (Exterior)	Wall	1/16" Lead Wall
G-A (Corridor)	Wall	1/16" Lead Wall
Ceiling (Multiuse)	Ground	1/16" Lead Center Above CT
Floor (Slab on Grade)	Door	None; Nothing Below.

Facility Drawing



Scatter Plots for CT



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EMPOWERCT AND EMPOWERCTA INJECTOR SYSTEM SITE SURVEY AND SITE INSTALLATION INSTRUCTIONS



ACIST Medical Systems, Inc., Eden Prairie, MN 55344
Phone: 952-941-3507 Fax: 952-941-4648

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Section 1: Introduction

1.1 PURPOSE OF THIS MANUAL

This document details information regarding the installation of the Empower family of CT Injector Systems. Included are the site survey instructions and the site survey checklist. Details are provided for overhead mounting installations. By following the instructions herein, the site will be ensured to receive the proper installation.

1.2 MANUAL ORGANIZATION

This document is organized into the following sections:

Section 1: Introduction	Identifies the purpose and organization of this manual.
Section 2: Site Survey	Contains site survey instructions
Section 3: Site Installation Instructions	Provides detailed instructions for Injector wall and ceiling mount
Section 4: Drawings	Provides illustrations of the Articulating Arm operating range for wall mount and ceiling mount configurations.

1.3 MANUAL CONVENTIONS

This manual uses the following conventions:

- ◆ **Bold** indicates emphasis or heading.
- ◆ *Note* is used to set off important information from the rest of the text.

This manual also uses the following warning format:



The **WARNING** symbol alerts you to a hazard that may result in equipment damage or personal injury.

Section 2: Site Survey

2.1 PURPOSE

The Site Survey is to be used to determine site requirements and system configuration for the most optimal installation of the Empower Injector System.

Important!

Please read all of Section 2 found at the end of section 2 prior to requesting shipment of the Empower Injector System.

2.2 GENERAL SITE CONSIDERATIONS

The following considerations must be reviewed prior to installation:

Power Requirements – The Empower Injector System requires a standard, hospital grade power source with a grounded receptacle. Line cords compatible with local voltages are provided with the system. A power source with a dedicated circuit is recommended for all ACIST Injector systems. Two dedicated outlets are required with the Empower Injector System. The first outlet is for the Power Supply and the second outlet is for the Remote Control. Before installation, take careful note as to where the outlets are located. These locations may affect the length of cables required of the installation. Power outlets should be either 120 VAC/60 Hz or 240 VAC/50 Hz.

Access – Patient access to the gantry (left and right sides) must not be impeded by the Injector system.



Cables on the floor are a potential hazard and should not be in the patient or site staff access path.

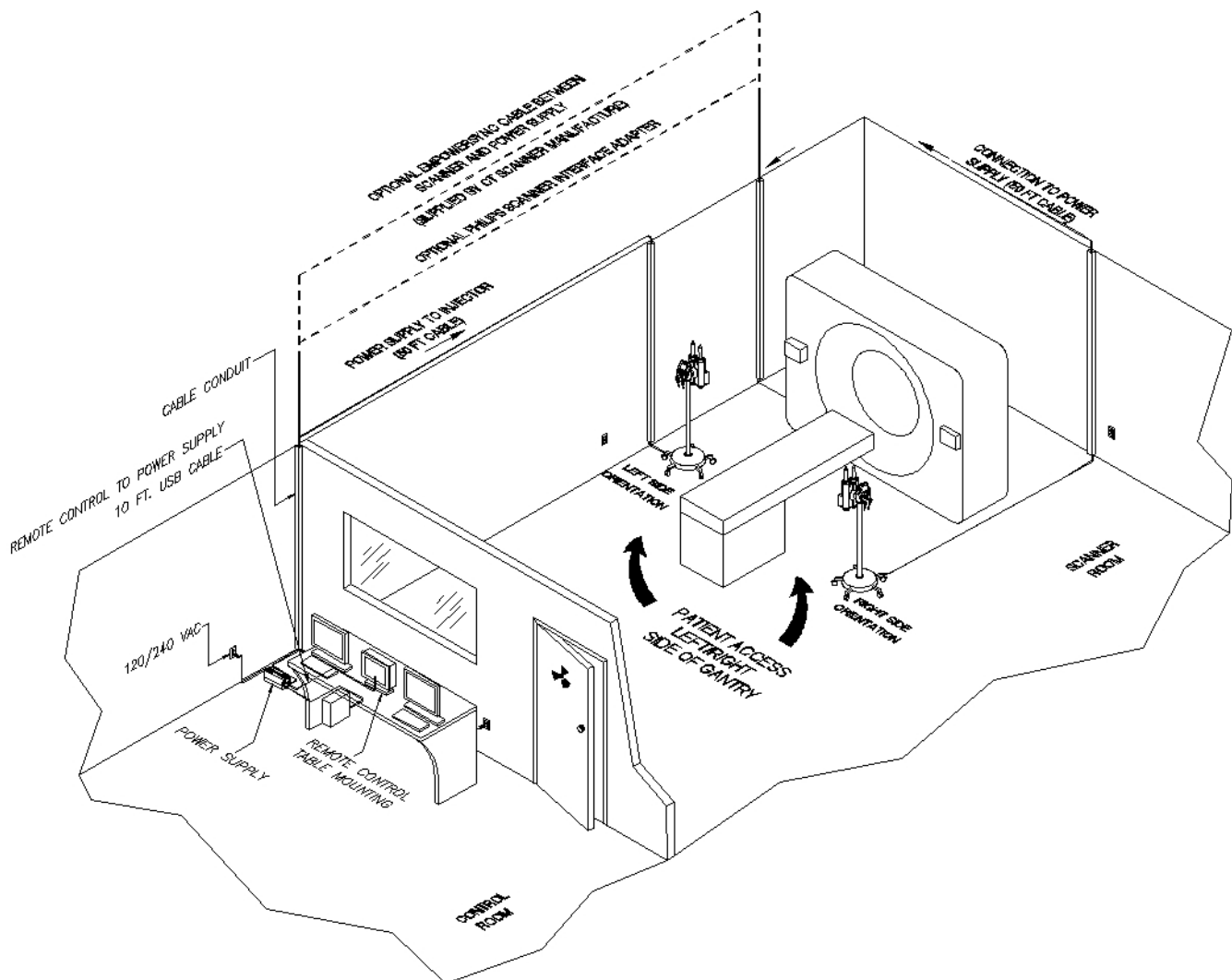
There are two types of Injector mounting possibilities: Floor Stand and Overhead (Ceiling/Wall) Mount.

2.3 FLOOR STAND

The floor stand assembly is comprised of a pole, base with casters and counterweight, and shroud. The Injector and Extravasation Detection Accessory (EDA)(optional), are mounted on the pole. Casters on the base facilitate movement and placement of the Injector throughout the scanner room.

Typical Floor Stand Installation

EMPOWERCTA Injector System is shown



2.4 OVERHEAD (CEILING/WALL) MOUNT

The overhead configuration is comprised of a ceiling column or wall mount bracket, articulating arm, and Injector mounting arm. The Injector and the Extravasation Detection Accessory (EDA)(optional) are mounted on the Injector mounting arm.

Prior to installation of the overhead mount, a suitable structure (for example: uni-strut) must be located that will support the load of the Empower Injector System and mount. Facility Engineering or other knowledgeable personnel should be consulted regarding all installations.

Important!

The customer is responsible for the installation of the Injector System Ceiling Mount Column or Wall Mount bracket.

See section 4-6 for calculations related to the Empower Injector System.

It is recommended that two (2) people perform the installation on the Injector System Ceiling Mount Column.

The Customer must provide fasteners and anchors for mounting the Ceiling Mount Column and Wall Mount Bracket:

- . • Wall mount systems (2) each.
- . • Ceiling mount systems (4) each.
- . • An optional adapter plate is available requiring additional hardware.

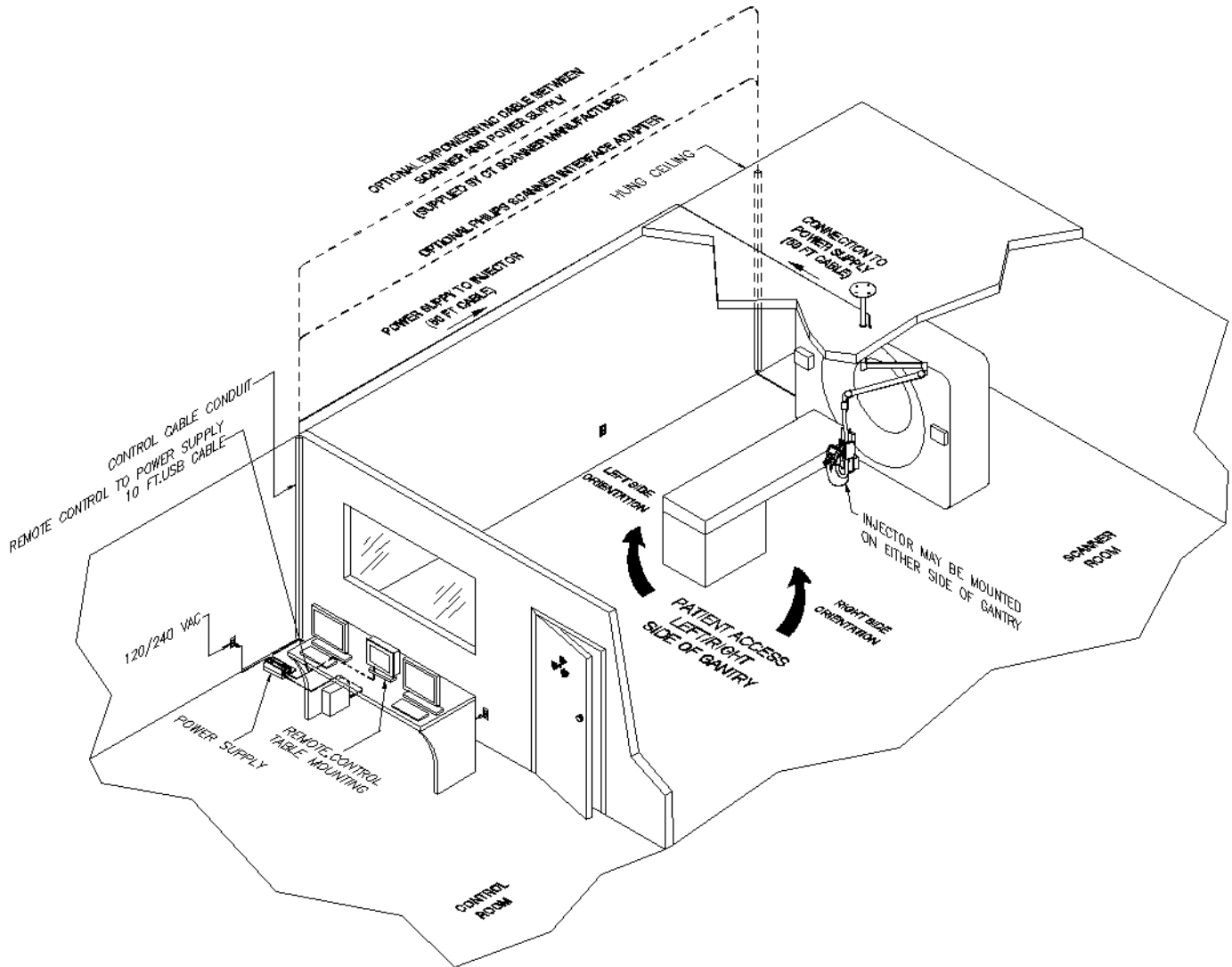
Lengths – Three different column lengths are available S (11.25"), M (21.50"), and L (34.50").

Clearance – Once installed, the horizontal member of the Articulating Arm must be able to clear the top of the scanner such that the injector can either be placed in front or behind the CT scanner during a procedure.

Minimum Height – To ensure optimal vertical injector range of motion with respect to patient height, the minimum height of the bottom of the Ceiling Mount Column should be 84" (7 feet) from the floor. The bottom of the Injector should be a minimum of 36" (3 feet) off the floor. The minimum height of the bottom of the Wall Mount should be 96" (8 feet) off the floor.

Typical Overhead Installation

EMPOWERCTA Injector System is shown



Section 3: Installation

Instructions of Overhead or Wall Mount

3.1 INSTALLATION OVERVIEW

After the site survey form has been completed and sent to ACIST Medical Systems, Customer Service will review the form and the order will be entered in accordance with the information provided on the form. The appropriate system and accessories will be sent to the site.

It is the responsibility of the site to install the Ceiling Column or Wall Mount Bracket for the Articulating Arm.

The use of non-ACIST Medical Systems Ceiling Column or Wall mounts will void the warranty.

3.2 CEILING MOUNT COLUMN INSTALLATION

Install the Ceiling Mount Column as follows:

1. Remove the Ceiling Mount Column from its packaging and position the Pivot Shaft (see Fig. 3-1b) of the column such that the range of motion that is full range (approximately 270 degrees) of the articulating arm. The pivot shaft can be orientated in any position prior to securing the ceiling column to its support structure. Select the pivot shaft orientation such that the resulting range of motion best addresses the operational requirements of the site (See Fig. 4-2).
2. Mark the locations of the holes by using the Ceiling Mount Column drawing (see Fig. 4-5). Drill mounting holes at the locations marked on the plate. Mount the plate.
3. Install the Ceiling Mount Column using the appropriate fasteners and anchors (**NOT PROVIDED**) (see Fig. 3-1a) to the plate. Ensure that the base of the column is level.



Figure 3-1a: Ceiling Mount Column
(Pattern for Competitor column not shown)

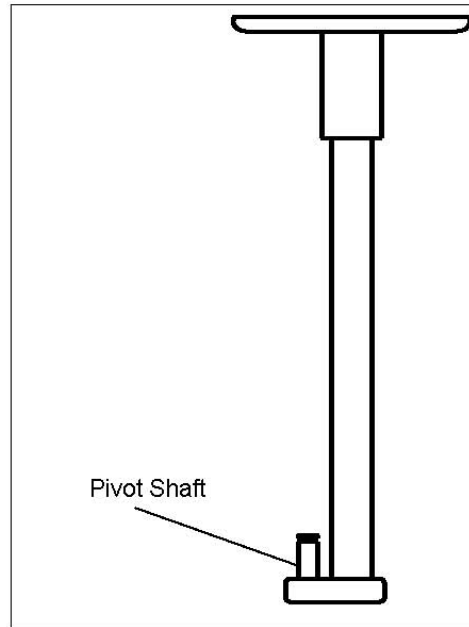


Figure 3-1b: Pivot Shaft

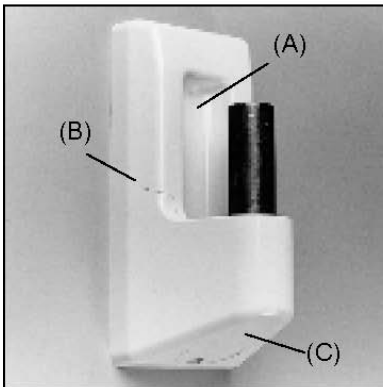


Figure 3-2a: Wall-Mount Bracket

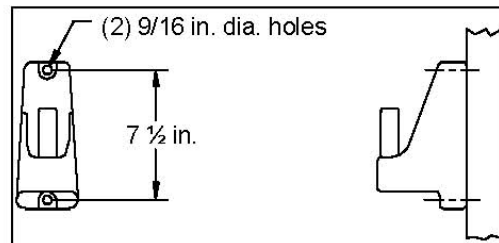


Figure 3-2b: Wall-Mount Bracket

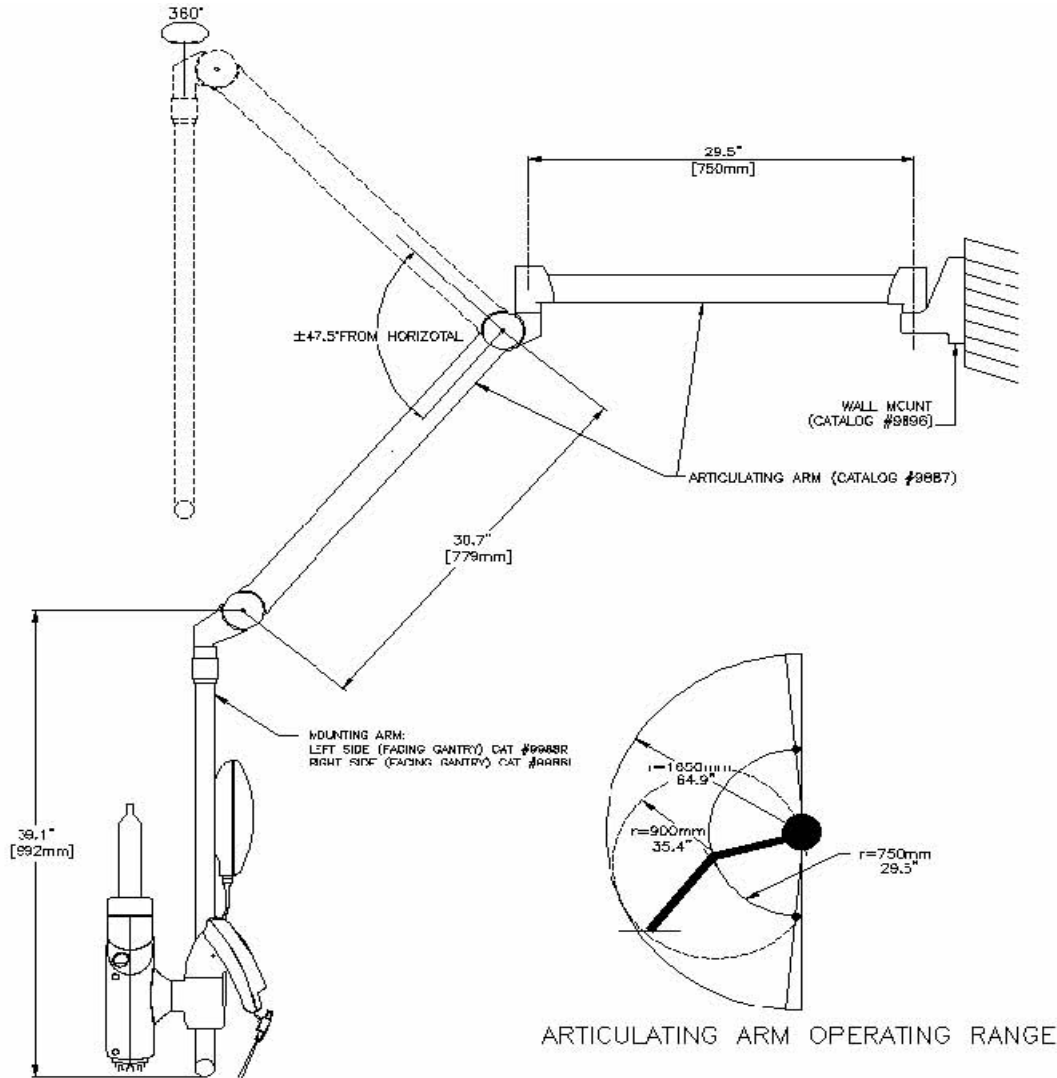
3.3 WALL MOUNT BRACKET INSTALLATION

Install the Wall Mount Bracket as follows:

1. Remove the Wall Mount Bracket from its packaging.
2. Unsnap and remove plastic cover (A), plastic housing (B), and plastic plug (C) (see Fig. 3-2a).
3. Place the Wall Mount Bracket against the surface where it will be mounted. Mark the location of the holes by using the bracket as a template (see Fig. 3-2b)
4. Drill mounting holes at the appropriate points.
5. Install the Wall Mount Bracket using the appropriate fasteners and anchors (not provided). Replace the plastic covers and plug removed in Step 2, above. Make certain that the bracket is level.

Section 4: Drawings

4.1 ARTICULATING ARM OPERATING RANGE - WALL MOUNT

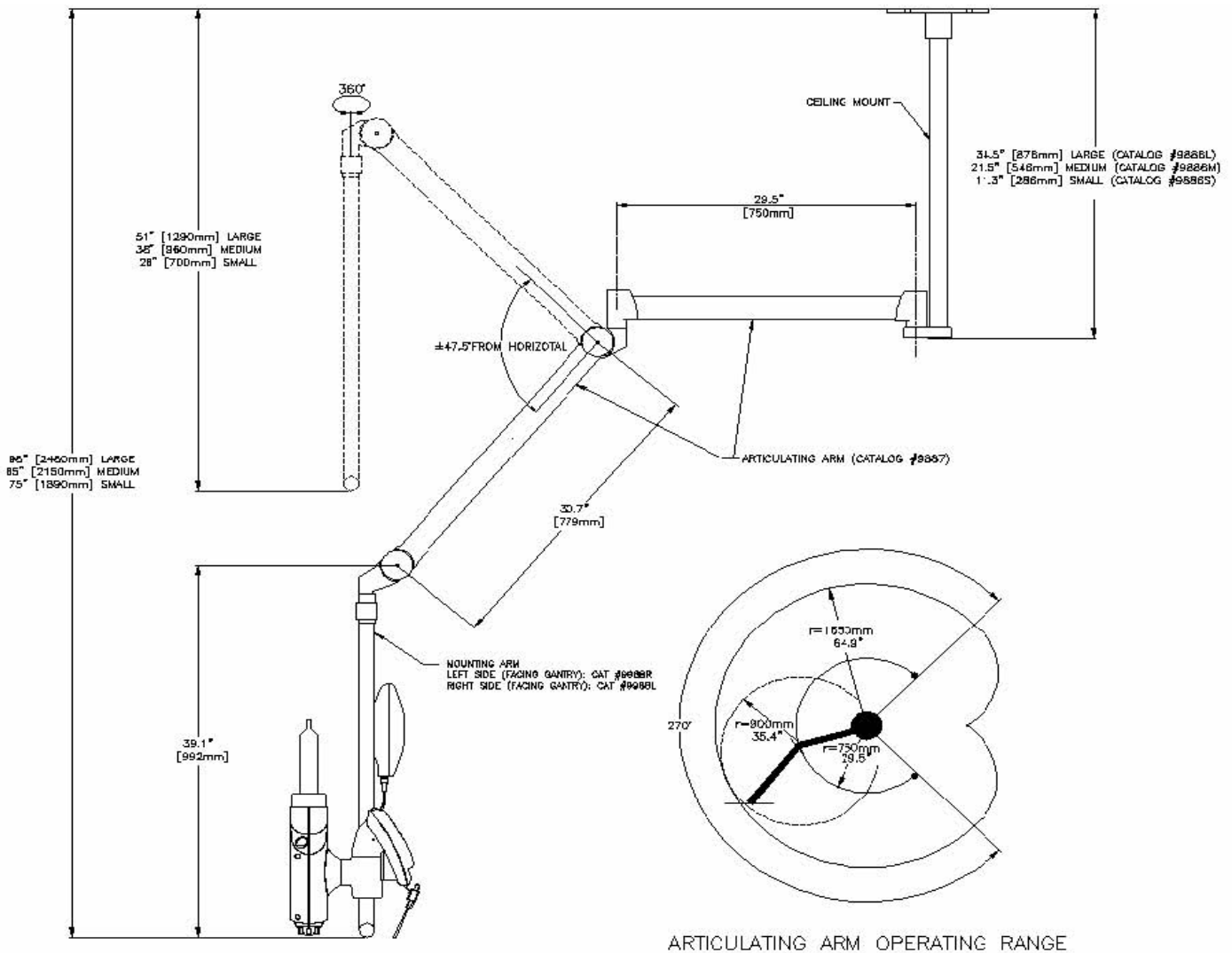


WEIGHT SPECIFICATIONS:

EmpowerCT Injector with:
Mounting Arm, 200ml syringe,
EDA, heater and cables: 20 lbs
Wall Mount: 5 lbs
Articulating Arm: 22 lbs
Injector Mounting Arm: 5 lbs
Total System Weight: 52 lbs

EmpowerCTA Injector with:
Mounting Arm, 200ml syringe,
EDA, heater and cables: 28 lbs
Wall Mount: 5 lbs
Articulating Arm: 22 lbs
Injector Mounting Arm: 5 lbs
Total System Weight: 60 lbs

4.2 ARTICULATING ARM OPERATING RANGE - CEILING MOUNT



WEIGHT SPECIFICATIONS:

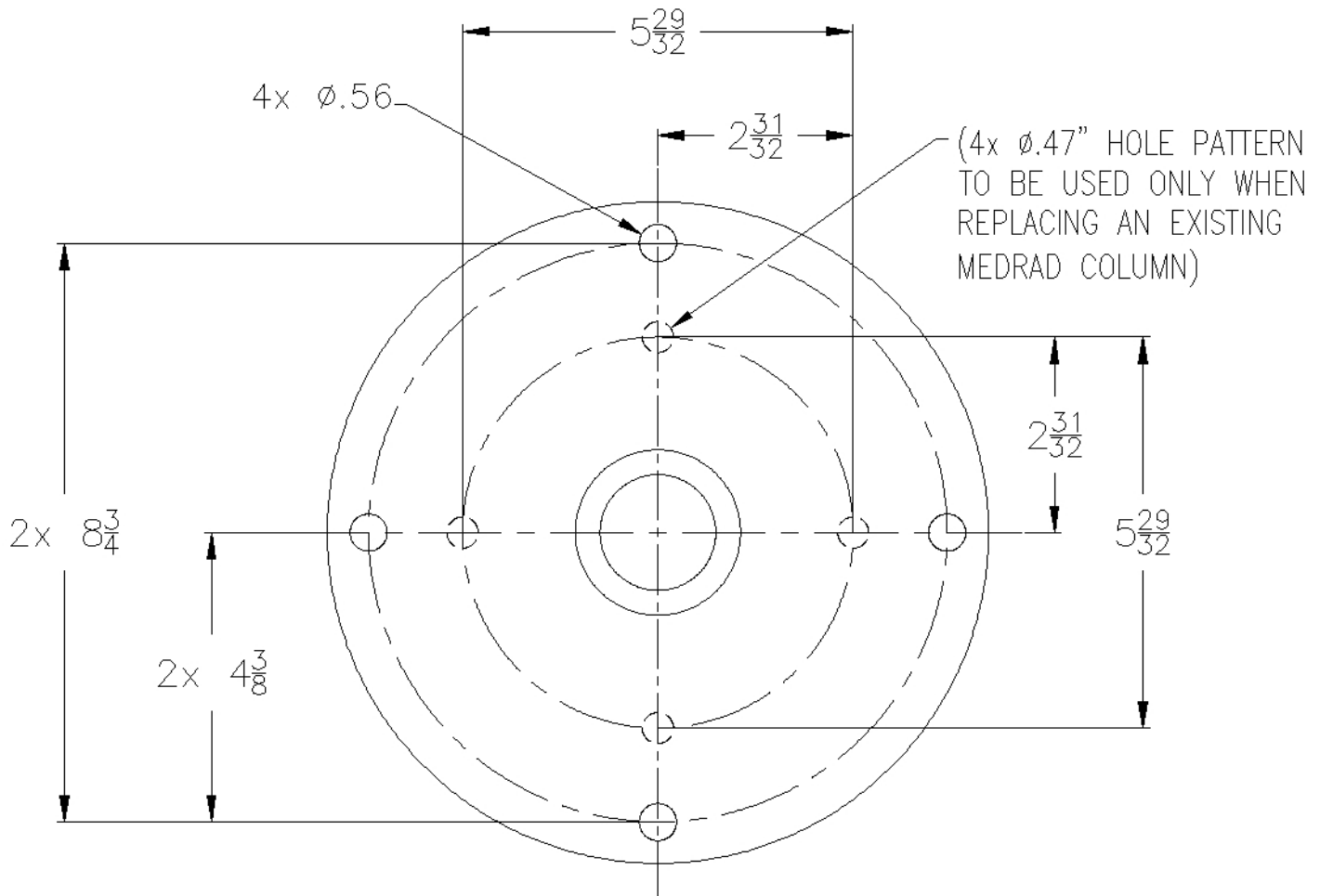
EmpowerCT Injector with: Mounting Arm, 200ml syringe, EDA, heater and cables:	20 lbs
Small ceiling mount:	19 lbs
Medium ceiling mount:	22 lbs
Large ceiling mount:	26 lbs
Articulating Arm:	22 lbs
Injector Mounting Arm:	5 lbs
Total System Weight:	
With small mount:	66 lbs
With medium mount:	69 lbs
With large mount:	73 lbs

EmpowerCTA Injector with: Mounting Arm, 200ml syringe, EDA, heater and cables:	28 lbs
Small ceiling mount:	19 lbs
Medium ceiling mount:	22 lbs
Large ceiling mount:	26 lbs
Articulating Arm:	22 lbs
Injector Mounting Arm:	5 lbs
Total System Weight:	
With small mount:	74 lbs
With medium mount:	77 lbs
With large mount:	81 lbs

4.3 CEILING COLUMN MOUNTING HOLE LOCATIONS

(DRAWING NOT TO SCALE)

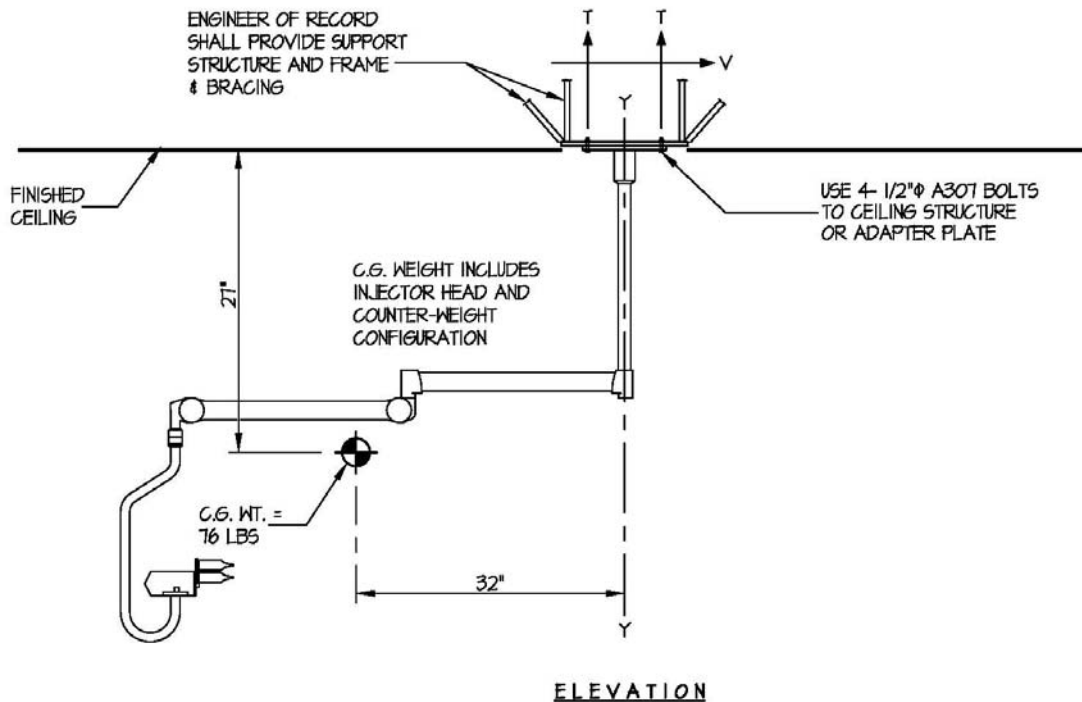
(ALL DIMENSIONS ARE INCHES)



Section 5: EASE Calculations

EASE EQUIPMENT ANCHORAGE & SEISMIC ENGINEERING		
ACIST MEDICAL SYSTEMS	DES. R. LA BRIE	SHEET 1
	JOB NO. 11-0766	OF 3 SHEETS
EmpowerCTA CEILING SUSPENDED INJECTOR	DATE 6/5/09	

SEISMIC ANCHORAGE



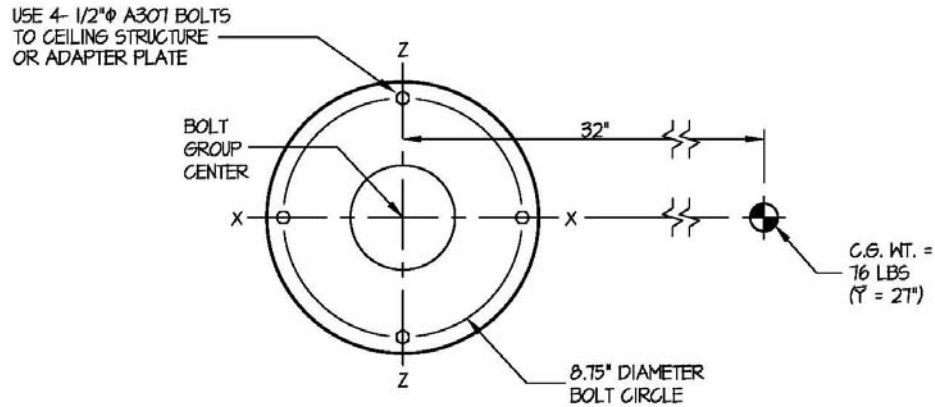
NOTES:

- FORCES ARE DETERMINED PER 2007 CALIFORNIA BUILDING CODE SECTION 1613A AND ASCE 7-05 SECTIONS 12 AND 13. ALLOWABLE STRESS DESIGN IS USED.
 HORIZONTAL FORCE (E_H) = $2.43 W_p$ ($S_{os} = 1.93, a_p = 2.5, I_p = 1.5, R_p = 2.5$)
 VERTICAL FORCE (E_V) = $0.27 W_p$
- CENTER OF GRAVITY (C.G.) WEIGHT IS A MAXIMUM. THIS CALCULATION ENCOMPASSES ALL WEIGHTS UP TO THE MAXIMUM WEIGHT SHOWN.
- ARCHITECT OR STRUCTURAL ENGINEER OF RECORD SHALL PROVIDE SUPPORT STRUCTURE TO SUPPORT WEIGHTS AND FORCES SHOWN.



EASE EQUIPMENT ANCHORAGE & SEISMIC ENGINEERING		
ACIST MEDICAL SYSTEMS	DES. R. LA BRIE	SHEET 2
	JOB NO. 11-0766	
EmpowerCTA CEILING SUSPENDED INJECTOR	DATE 6/5/09	OF 3 SHEETS

SEISMIC ANCHORAGE



PLAN AT MOUNTING PLATE

LOADS:

WEIGHT = 76 LBS
 HORIZONTAL FORCE (E_H) = 185 LBS
 VERTICAL FORCE (E_V) = 21 LBS

BOLT GROUP PROPERTIES:

I_{X-X} = 38 in.⁴
 I_{Z-Z} = 38 in.⁴
 I_{Y-Y} = 76 in.⁴

MOMENTS:

M_{XX} = 185#(27") + (76# + 21#)32" = 8,099#"
 M_{ZZ} = 185#(27") + (76# + 21#)32" = 8,099#"
 M_{YY} = 0#"
 (UNIT IS FREE TO ROTATE 360°)

BOLT FORCES:

TENSION (T)

$$T = \frac{8099\text{in}^2(4.38\text{in})}{38} + \frac{76\# + 21\#}{4} = 958 \text{ LBS/BOLT (MAX)}$$

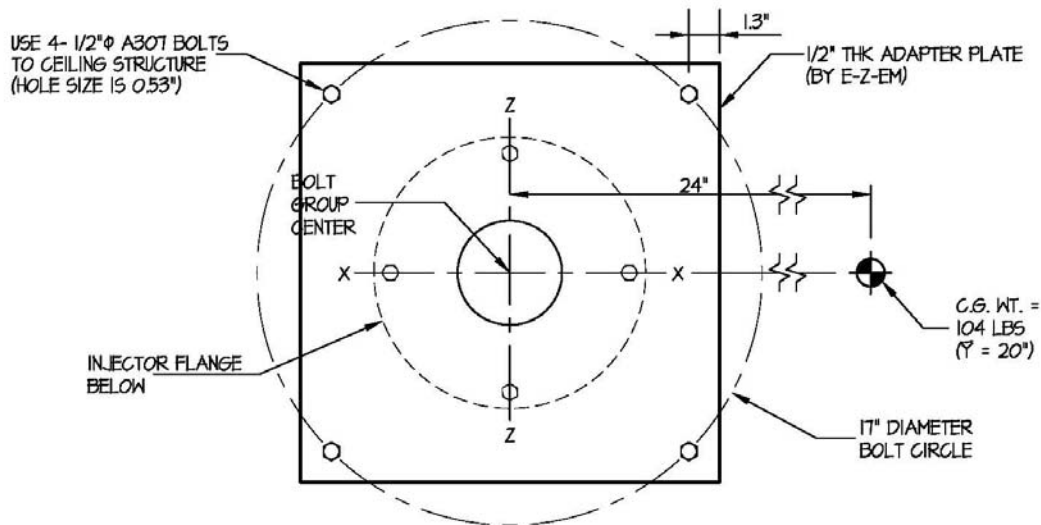
SHEAR (V)

$$V = \frac{185\#}{4} = 46 \text{ LBS/BOLT (MAX)}$$

EASE EQUIPMENT ANCHORAGE & SEISMIC ENGINEERING		
ACIST MEDICAL SYSTEMS	DES. R. LA BRIE	SHEET 3
	JOB NO. 11-0766	OF 3 SHEETS
EmpowerCTA CEILING SUSPENDED INJECTOR	DATE 6/5/09	

SEISMIC ANCHORAGE

ADAPTER PLATE OPTION



PLAN AT ADAPTER PLATE OPTION

LOADS:

WEIGHT = 104 LBS (INCLUDES ADAPTER PLATE)

HORIZONTAL FORCE (E_H) = 253 LBS

VERTICAL FORCE (E_V) = 28 LBS

BOLT GROUP PROPERTIES:

|X-X = 144 in.⁴
|Z-Z = 144 in.⁴
|Y-Y = 288 in.⁴

MOMENTS:

M_{XX} = 253#(20") + (104# + 28#)24" = 8,228"#
M_{ZZ} = 253#(20") + (104# + 28#)24" = 8,228"#
M_{YY} = 0"# (UNIT IS FREE TO ROTATE 360°)

BOLT FORCES:

TENSION (T)

$$T = \frac{8228\text{"#}(8.9")}{144} + \frac{104\# + 28\#}{4} = 542 \text{ LBS/BOLT (MAX)}$$

SHEAR (V)

$$V = \frac{253\#}{4} = 63 \text{ LBS/BOLT (MAX)}$$



Sheet 1 of 4

**Office of Statewide Health Planning and Development
ANCHORAGE PRE-APPROVAL**

OPA-1816-07

Equipment Manufacturer: ACIST Medical Systems

Equipment Type: EmpowerCTA Ceiling Suspended Injector

GENERAL NOTES

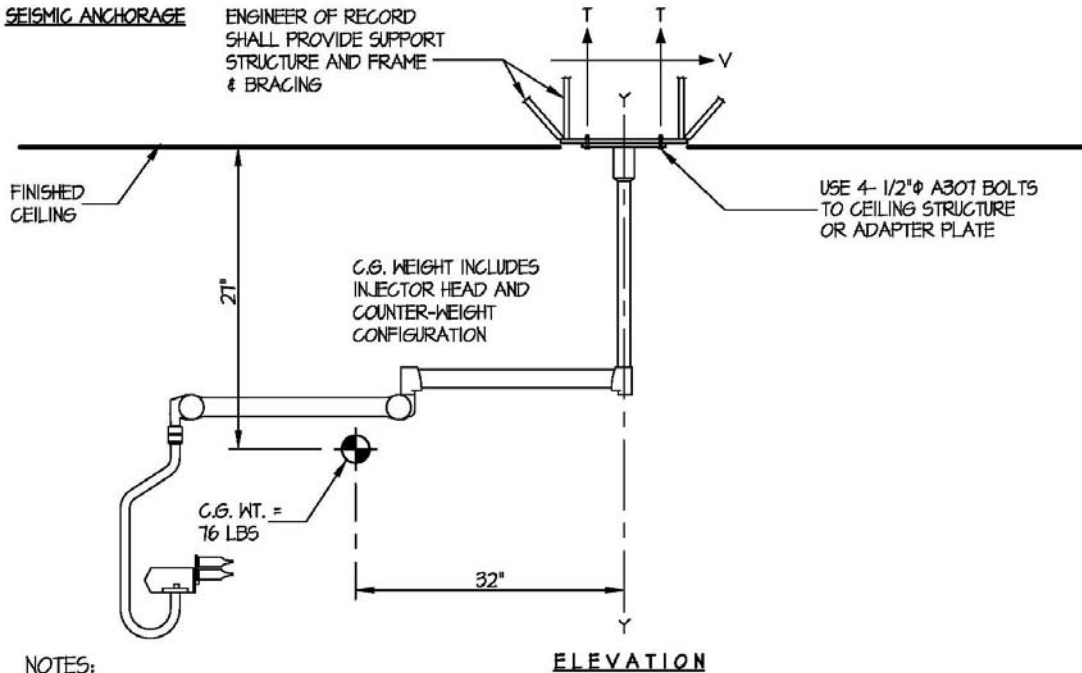
1. FORCES PER ASCE 7-05 SECTION 13.3.1, EQUATIONS 13.3-1, 13.3-2 & 13.3-3, WHERE $S_{DS} = 1.93$, $a_p = 2.5$, $I_p = 1.5$ & $R_p = 2.5$
2. THIS PRE-APPROVAL CONFORMS TO THE 2007 CALIFORNIA BUILDING CODE.
3. THE DETAILS IN THIS PRE-APPROVAL MAY BE USED AT ANY LOCATION IN THE STATE OF CALIFORNIA. THE ELEVATED FLOOR DETAILS MAY BE USED AT ANY HEIGHT IN A BUILDING.
4. ALL ANCHOR FORCES SHOWN ON THE DRAWINGS ARE WORKING LOADS (AS OPPOSED TO STRENGTH LEVEL LOADS) AND MAY BE USED FOR ALLOWABLE STRESS DESIGN.
5. PER CAN 2-1708A.5, THIS UNIT DOES NOT REQUIRE "SPECIAL SEISMIC CERTIFICATION".

RESPONSIBILITIES OF THE STRUCTURAL ENGINEER OF RECORD

6. DESIGN BACKING BARS, STUDS, ETC. WHICH THE UNITS ARE ATTACHED TO AS NOTED ON THE DRAWINGS. THE SEOR SHALL ALSO VERIFY THE ADEQUACY OF THE STRUCTURES (SUCH AS WALLS AND FLOORS) WHICH SUPPORT THE UNITS FOR THE LOADS IMPOSED ON THEM BY THE UNITS AS WELL AS ALL OTHER LOADS.
7. PROVIDE ANY SUPPORTING STRUCTURE REQUIRED TO SUPPORT WEIGHTS AND FORCES SHOWN, IN ADDITION TO ALL OTHER LOADS.
8. VERIFY THAT THE INSTALLATION IS IN CONFORMANCE WITH THE 2007 CBC AND WITH THE DETAILS SHOWN IN THIS PRE-APPROVAL. VERIFY THAT THE ACTUAL EQUIPMENT'S WEIGHT, CG LOCATION, ANCHOR LOCATIONS, ANCHOR DETAILS AND THE MATERIAL AND GAGE OF THE UNIT WHERE ATTACHMENTS ARE MADE AGREE WITH THE INFORMATION SHOWN ON THE PRE-APPROVAL DOCUMENTS.



EASE EQUIPMENT ANCHORAGE & SEISMIC ENGINEERING		
ACIST MEDICAL SYSTEMS	DES. R. LA BRIE	SHEET 2
EmpowerCTA CEILING SUSPENDED INJECTOR	JOB NO. 11-0766	OF 4 SHEETS
	DATE 1/16/09	



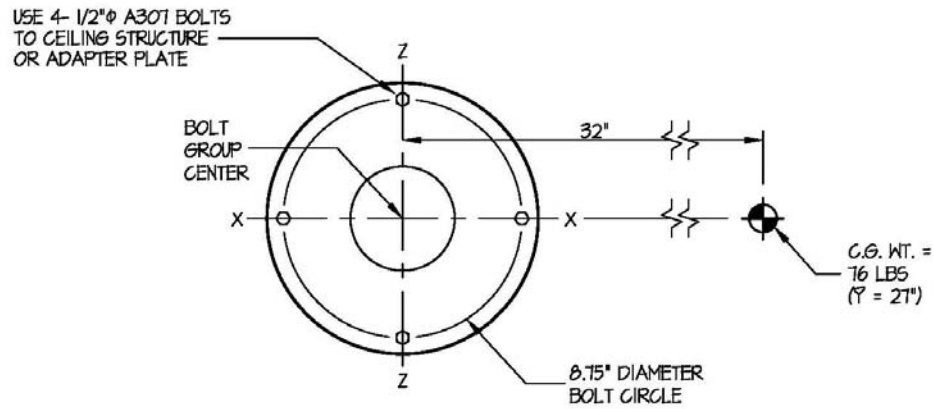
NOTES:

- ANCHORAGE DESIGN PER 2007 CALIFORNIA BUILDING CODE - SECTION 1613A AND ASCE 7-05 SECTIONS 12 AND 13. ALLOWABLE STRESS DESIGN IS USED.
 $HORIZONTAL\ FORCE\ (E_H) = 2.43\ W_p\ (S_{DS} = 1.93, I_p = 1.5, a_p = 2.5, R_p = 2.5)$
 $VERTICAL\ FORCE\ (E_v) = 0.27\ W_p$
- CENTER OF GRAVITY (C.G.) WEIGHT IS A MAXIMUM. THIS PRE-APPROVAL ENCOMPASSES ALL WEIGHTS UP TO THE MAXIMUM WEIGHT SHOWN.
- ARCHITECT OR STRUCTURAL ENGINEER OF RECORD SHALL PROVIDE SUPPORT STRUCTURE TO SUPPORT WEIGHTS AND FORCES SHOWN.
- SEE GENERAL NOTES: SHEET 1



EASE EQUIPMENT ANCHORAGE & SEISMIC ENGINEERING		
ACIST MEDICAL SYSTEMS	DES. R. LA BRIE	SHEET 3
EmpowerCTA CEILING SUSPENDED INJECTOR	JOB NO. 11-0766	OF 4 SHEETS
	DATE 6/5/09	

SEISMIC ANCHORAGE



PLAN AT MOUNTING PLATE

$T_{max} = 958 \text{ LBS/BOLT}$
 $V_{max} = 46 \text{ LBS/BOLT}$

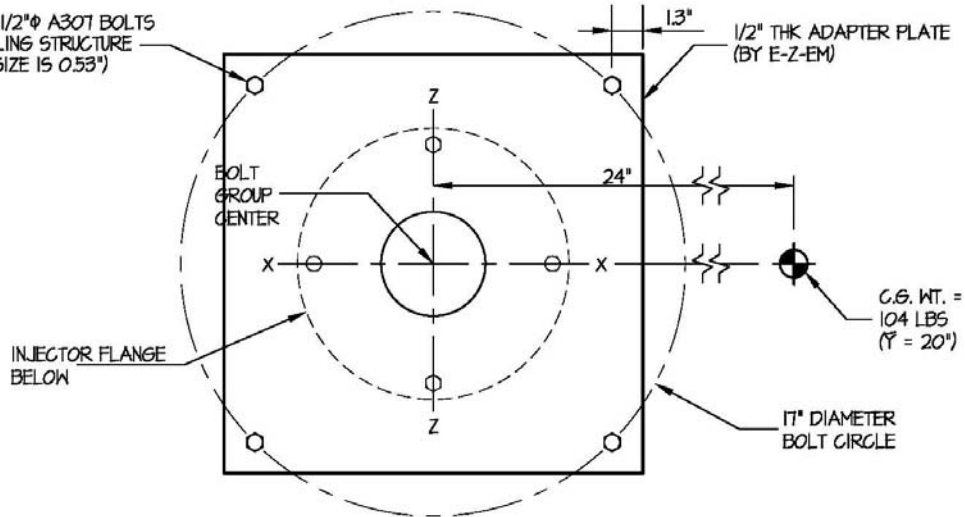


EASE EQUIPMENT ANCHORAGE & SEISMIC ENGINEERING		
ACIST MEDICAL SYSTEMS	DES. R. LA BRIE	SHEET 4
EmpowerCTA CEILING SUSPENDED INJECTOR	JOB NO. 11-0766	OF 4 SHEETS
	DATE 6/5/09	

SEISMIC ANCHORAGE

ADAPTER PLATE OPTION

USE 4- 1/2"Ø A307 BOLTS TO CEILING STRUCTURE (HOLE SIZE IS 0.53")



PLAN AT ADAPTER PLATE OPTION

T_{max} = 542 LBS/BOLT
V_{max} = 63 LBS/BOLT



The logo for TrueBeam, featuring a blue curved line above the word "trueBEAM" in a dark blue, sans-serif font. The "true" is in lowercase and "BEAM" is in uppercase.

trueBEAM

EQUIPMENT COORDINATION DRAWING
FOR

**Central Harnett
Hospital/ Cape Fear
Valley Health System
LILLINGTON, NC**

September 12, 2023

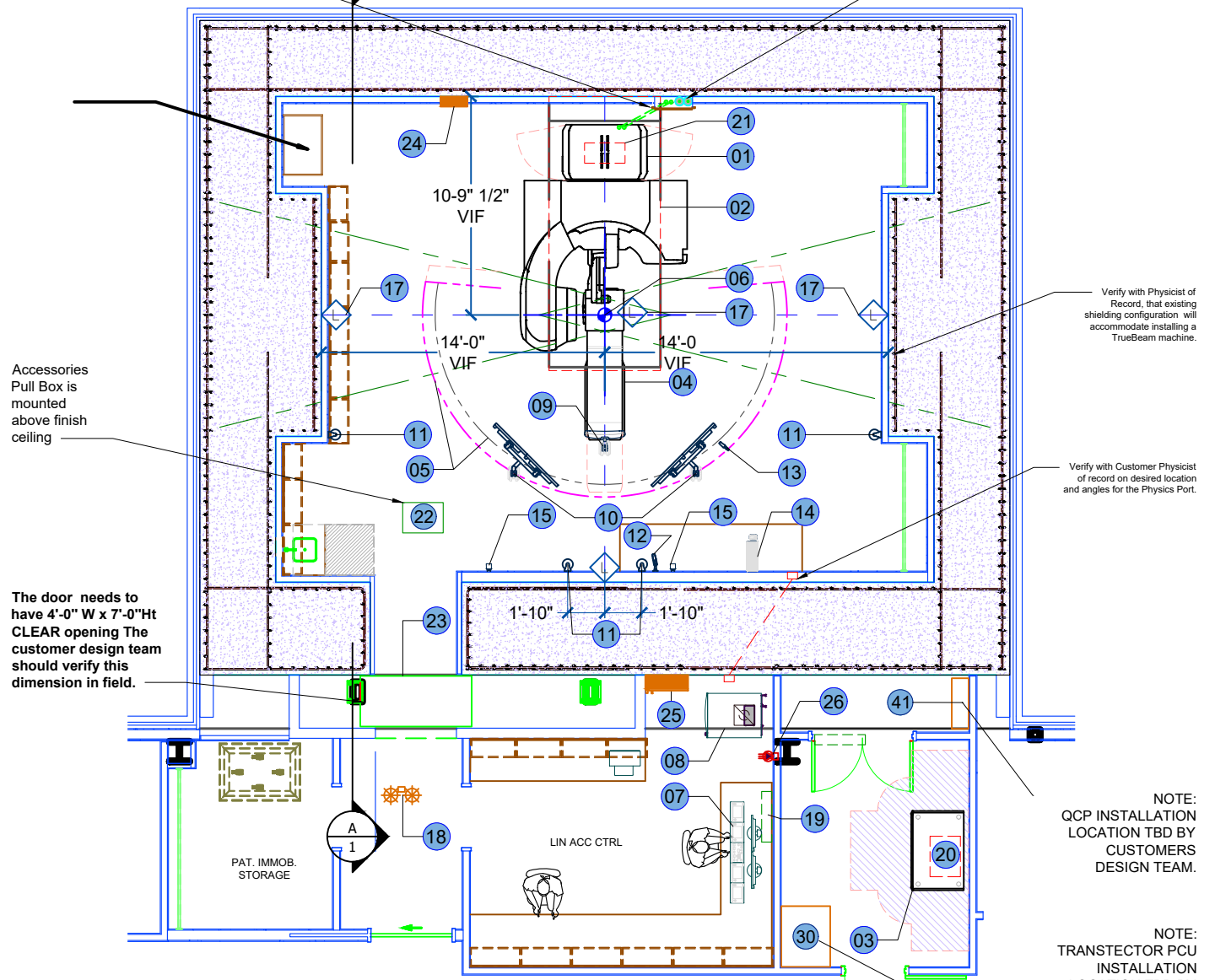
varian

A Siemens Healthineers Company



(2) 2" Chilled Water Conduit Sleeves w/12" radius bends Install against the BaseFrame before grout.

Locate Chilled Water Supply & Return Line Valves on Rear Concrete Wall at ~30" A.F.F. Provide Access Door.

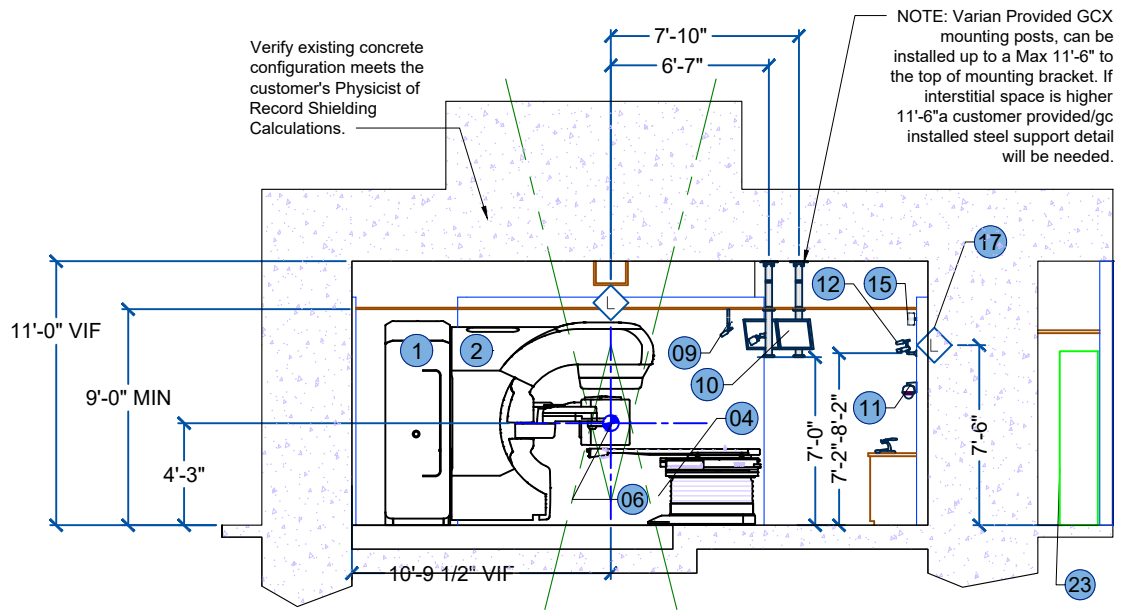


TrueBeam Plan
Scale: 1/8" = 1'-0"

NOTE: IF THIS PROJECT IS IN A SEISMIC ZONE. CONSULT PROJECT STRUCTURAL ENGINEER FOR EQUIPMENT ANCHORING SPECIFICATIONS.

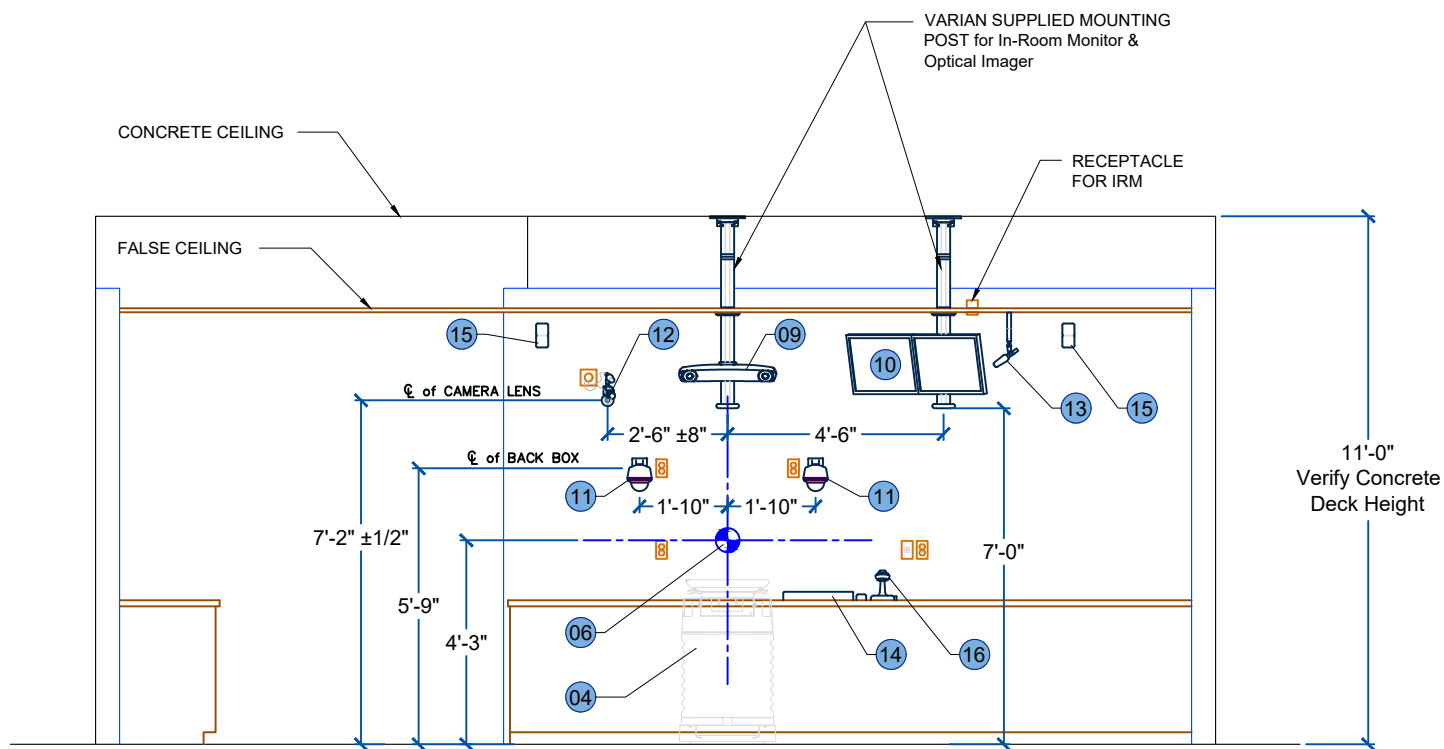
TrueBeam Components			Shielded Door		
01	Stand	VF/VI	23	(Verify with door manufacturer on overall dimensions and installation requirements)	CF/CI
02	Gantry	VF/VI	24	Relay Junction Box (20"H x 16"W x 6"D)	VF/CI
03	Modulator Cabinet	VF/VI	25	Main Circuit Breaker Panel (37 1/4"H x 25 1/2"W x 9 1/4"D, 179 lbs.)	VF/CI
04	Treatment Couch	VF/VI	26	IEC 60309 Receptacle	VF/CI
05	Couch Rotation Arcs (min. mandatory 8'-4 1/2" and max. 9'-0")	-	30	Transtector Power Conditioner (66"H x 29"W x 36"D, 1,142 lbs.)	VF/CI
06	Isocenter	-	40	Filtrine Chiller	VF/CI
07	TrueBeam Workstation Dedicated Keyboard & CCTV Monitors (Qty:2)	VF/VI	41	Filtrine Quick Connect Panel (36"H x 30"W x 10"D, 250 lbs.)	VF/CI
08	Control Cabinet, 2-1 Configuration (5'-1 7/16"H x 2'-2 7/16"W x 2'-9 7/16"D)	VF/VI	VF = Varian Furnished, CF = Contractor Furnished, VI = Varian Installed, CI = Contractor Installed		
09	Optical Imaging Camera Note ¹	VF/VI	Note ¹ : Contractor to install mounting hardware.		
10	In-Room Monitors (Qty:2 Set) Note ¹	VF/VI	Quote #:2021-338819-1		
11	CCTV Camera (Qty:4) Note ¹	VF/VI	12	Live View Camera w/Mic Note ¹	VF/VI
			13	Microphone (ceiling) Note ¹	VF/VI
			14	Wireless Keyboard/Mouse	VF/VI
			15	Speaker (Qty:2) Note ¹	VF/CI
			17	Patient Positioning Lasers (Qty:4) 2 side, 1 sagittal, and 1 ceiling, LAP Apollo (Blue, Green or Red), Note ¹	TBD
			18	Warning Lights (Qty:2) Beam-On & X-Ray-On, verify additional requirements with the regional regulatory agency	CF/CI
			19	Control Console Pull Box (size may vary, 30"W x 12"H x 6"D min.)	CF/CI
			20	Modulator Pull Box	CF/CI
			21	BaseFrame Pull Box	CF/CI
			22	Accessory Pull Box (size may vary, 24"W x 18"L x 12"D min.)	CF/CI

NOTE: CROSS-SECTION AND/OR STRUCTURAL DRAWINGS NOT PROVIDED. SECTION IS ONLY TYPICAL. DOES NOT REFLECT SITE SPECIFIC CONDITIONS.



Typical Section - Side Elevation
Scale: 1/8" = 1'-0"

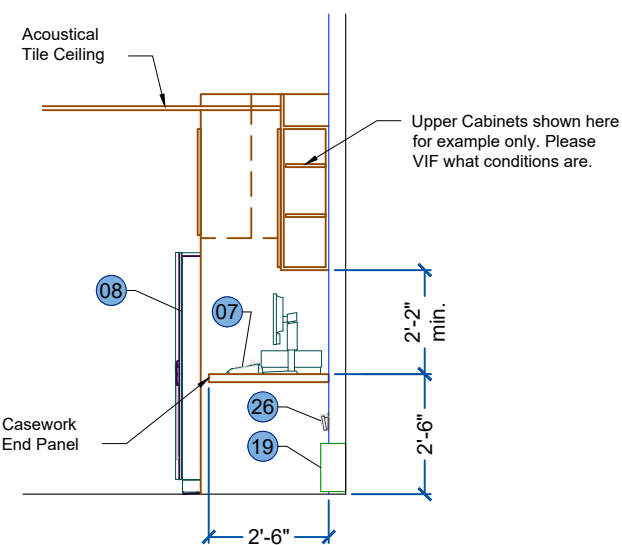
REFERENCE NOTES		TrueBeam Equipment Coordination Drawing for CENTRAL HARNETT HOSPITAL/ CAPE FEAR VALLEY HEALTH SYSTEM LILLINGTON, NC					
DESCRIPTION OF CHANGE	A. THIS DRAWING IS NOT FOR CONSTRUCTION. ALL SITE SPECIFIC INFORMATION WAS PROVIDED BY THE CUSTOMER. VERIFY ALL EXISTING CONDITIONS IN THE FIELD.	DRAWN BY	DATE	APPROVED BY	DATE	APPROVED BY	DATE
	B. THIS DRAWING IS NOT COMPLETE. THE CURRENT PRODUCT PLANNING GUIDE (PPG) TrueBeam EDITION IS TO BE USED FOR NEW OR REMODELED THERAPY ROOM PLANNING. THE PPG PROVIDES ALL THE ESSENTIAL INFORMATION AND REQUIREMENTS FOR INSTALLATION.	C.LINARES	11 SEP 2023	#			
C. THE FINAL SIGNED SALES ORDER WILL DETERMINE THE ITEMS FURNISHED BY VARIAN. THE CUSTOMER SIGNED SALES ORDER WILL TAKE PRECEDENCE OVER ANY ITEMS REPRESENTED IN THIS DRAWING.	DIMENSIONS: ft - in [mm]						PAGE 1
	NOT FOR CONSTRUCTION						OF 8
	© 2023, Varian Medical Systems, Inc.						
DATE		varian				B	23-004699
REV		SIZE				DRAWING NO.	REV. EC0



NOTE:
If Concrete Deck Height exceeds 12'-0", Contact Varian Regional Planner for CRITICAL Camera Mounting Specifications.

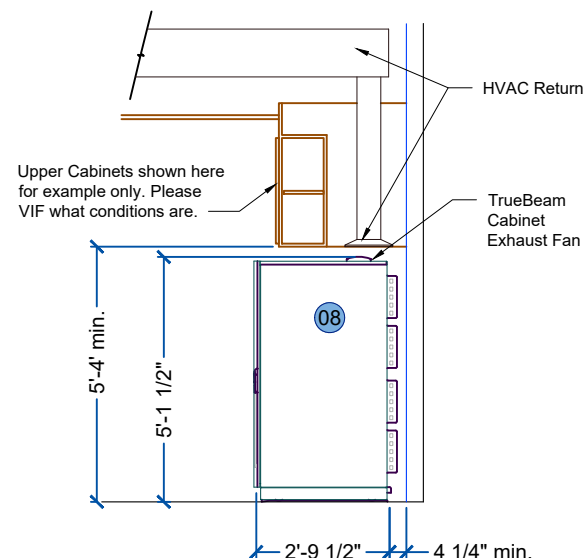
TrueBeam Sagittal Wall Elevation

Scale: 1/4" = 1'-0"



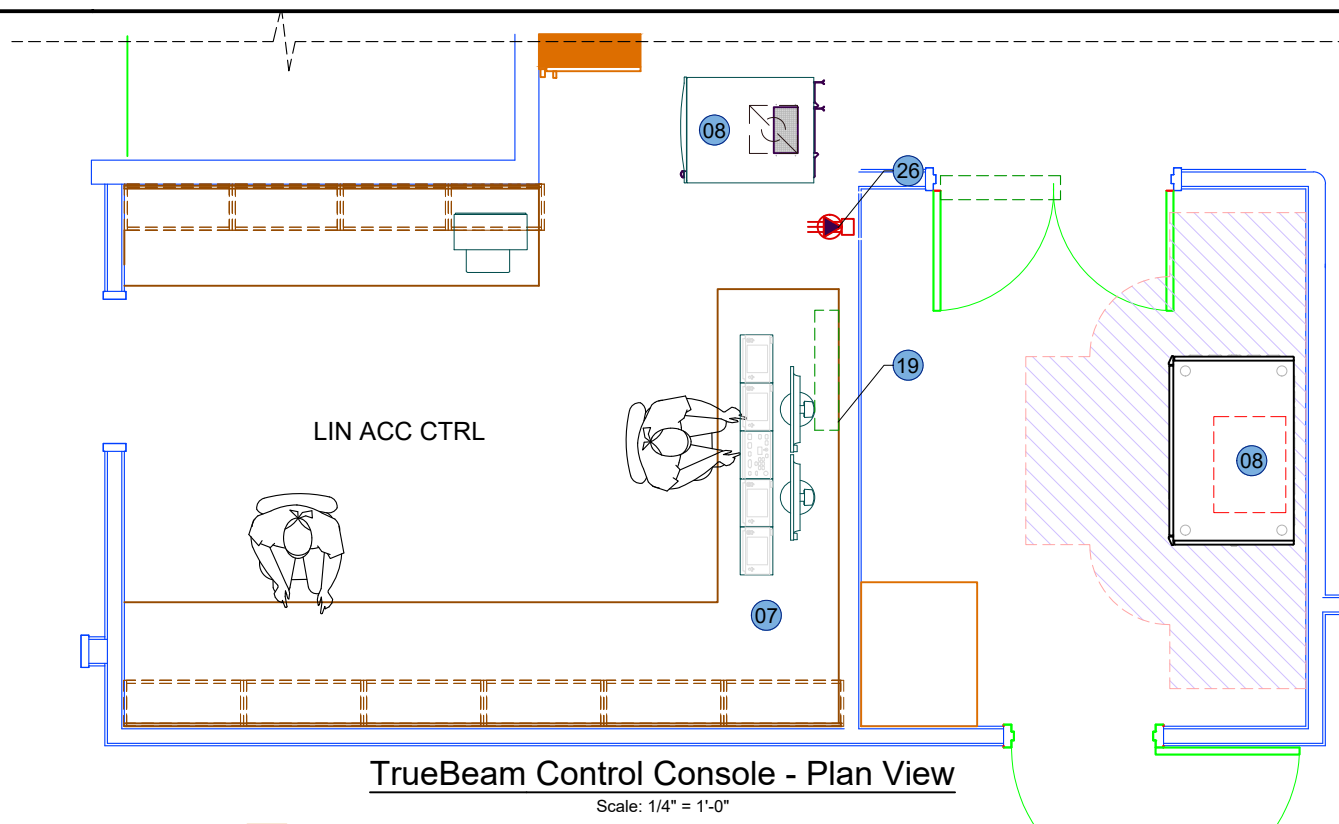
C2 - TrueBeam Control Console Section at Counter

Scale: 1/4" = 1'-0"



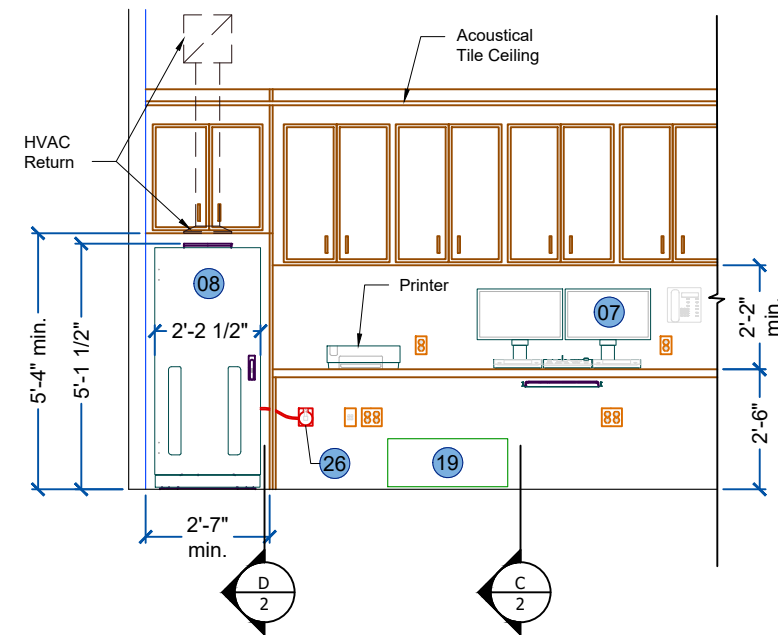
D2 - TrueBeam Control Console Section at Cabinet

Scale: Custom



TrueBeam Control Console - Plan View

Scale: 1/4" = 1'-0"



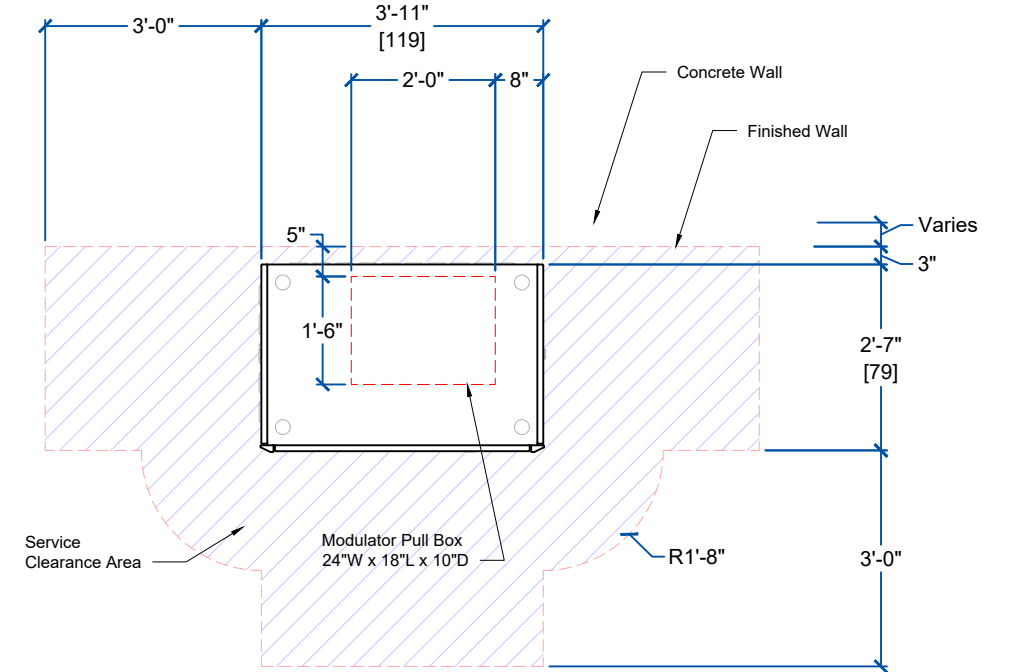
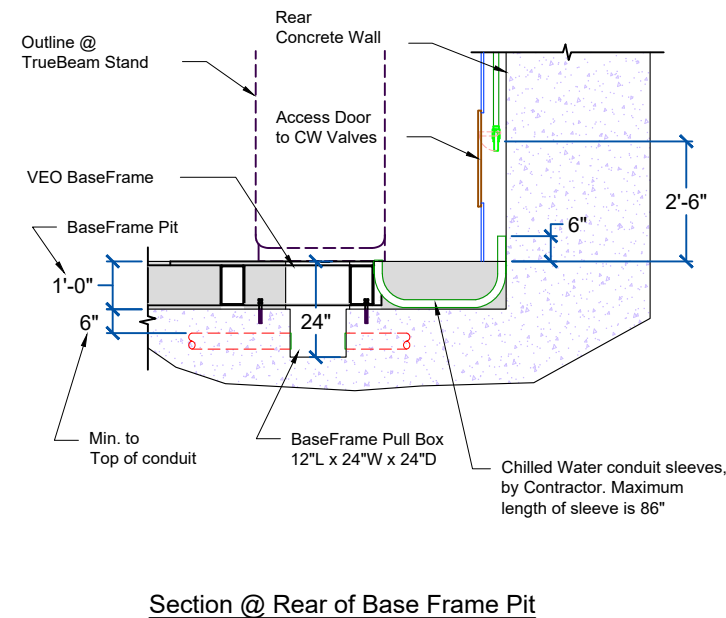
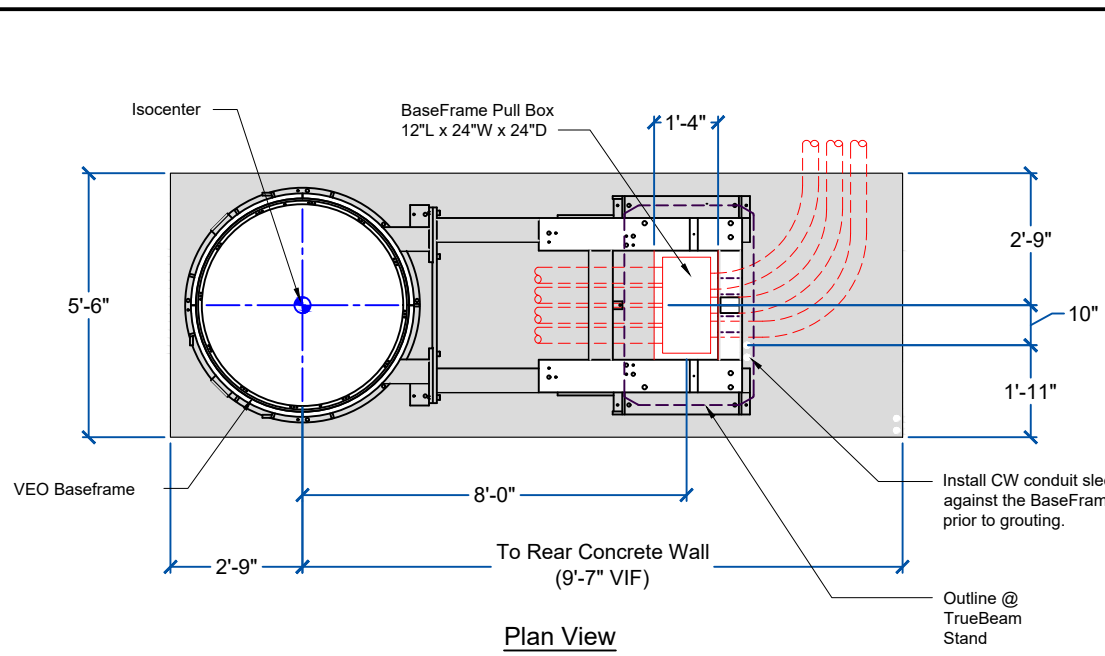
TrueBeam Typical Control Console - Elevation View

Scale: 1/4" = 1'-0"

REFERENCE NOTES

- A. THIS DRAWING IS NOT FOR CONSTRUCTION. ALL SITE SPECIFIC INFORMATION WAS PROVIDED BY THE CUSTOMER. VERIFY ALL EXISTING CONDITIONS IN THE FIELD.
- B. THIS DRAWING IS NOT COMPLETE. THE CURRENT PRODUCT PLANNING GUIDE (PPG) TrueBeam EDITION IS TO BE USED FOR NEW OR REMODELED THERAPY ROOM PLANNING. THE PPG PROVIDES ALL THE ESSENTIAL INFORMATION AND REQUIREMENTS FOR INSTALLATION.
- C. THE FINAL SIGNED SALES ORDER WILL DETERMINE THE ITEMS FURNISHED BY VARIAN. THE CUSTOMER SIGNED SALES ORDER WILL TAKE PRECEDENCE OVER ANY ITEMS REPRESENTED IN THIS DRAWING.

TrueBeam Equipment Coordination Drawing for CENTRAL HARNETT HOSPITAL/ CAPE FEAR VALLEY HEALTH SYSTEM LILLINGTON, NC					
DRAWN BY C.LINARES	DATE 11 SEP 2023	APPROVED BY #	DATE	APPROVED BY	DATE
DIMENSIONS: ft - in [mm] NOT FOR CONSTRUCTION					PAGE OF 2 8
varian				B SIZE	23-004699 DRAWING NO.
				EC0 REV.	

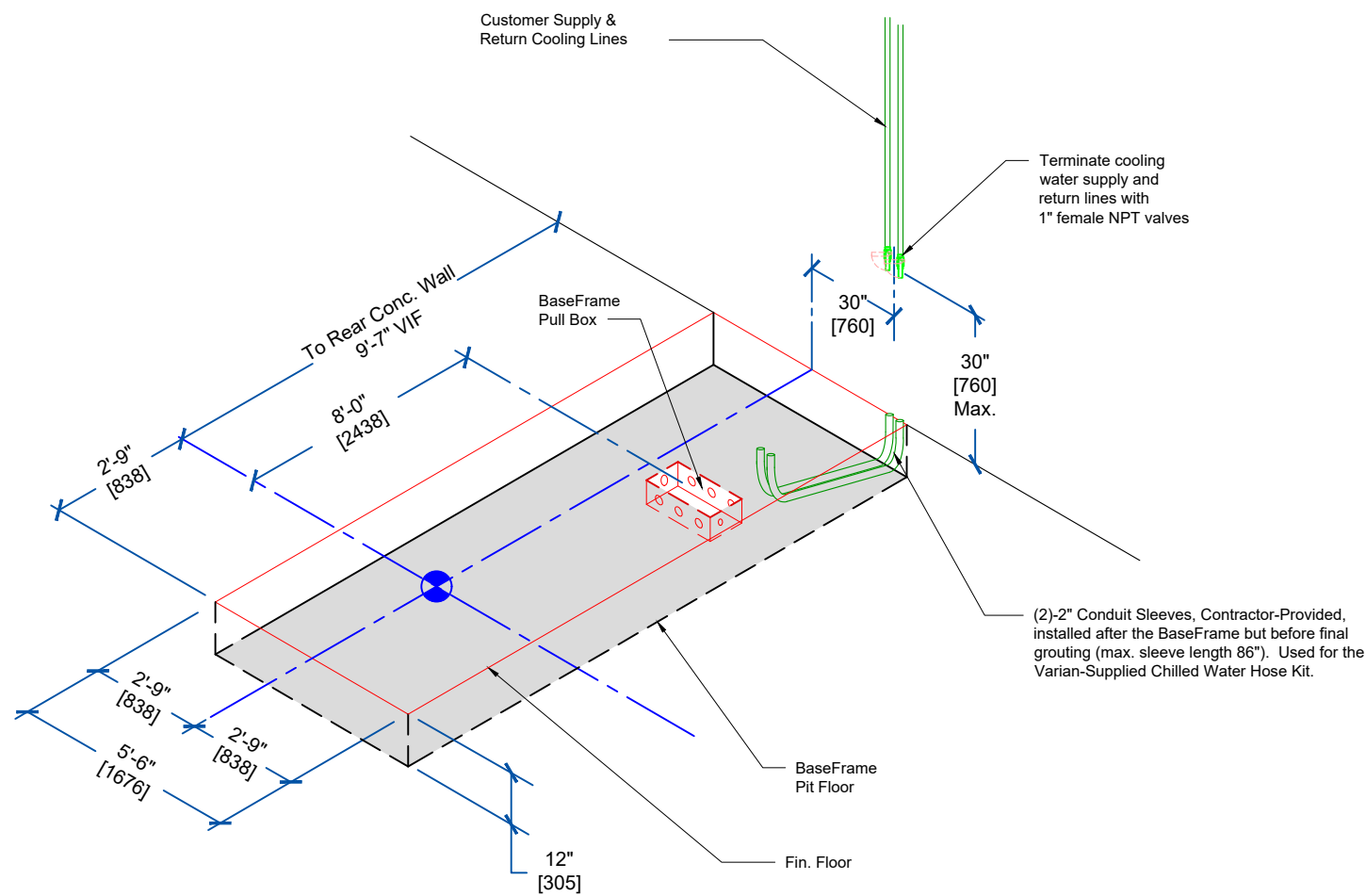


Standard Cable Access Plan & Section at Pull Box

Scale: 1/4" = 1'-0"

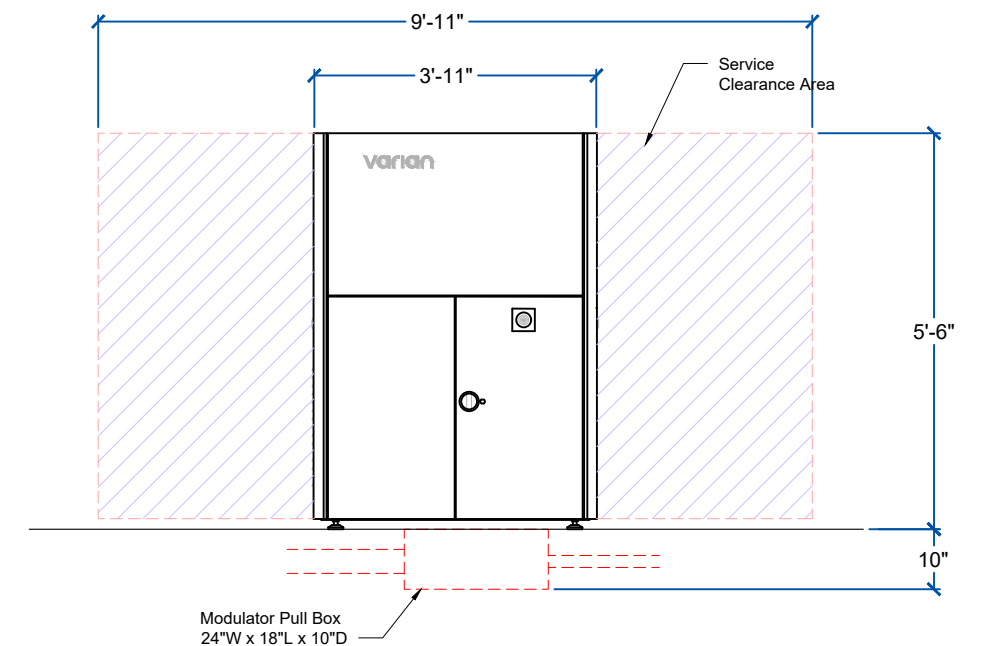
NOTE: NEC AND LOCAL CODE CLEARANCES ARE NOT REPRESENTED. CUSTOMER'S DESIGN TEAM IS RESPONSIBLE FOR CODE COMPLIANCE.

PLAN



BaseFrame Pit - Isometric View

Scale: 1/4" = 1'-0"



ELEVATION

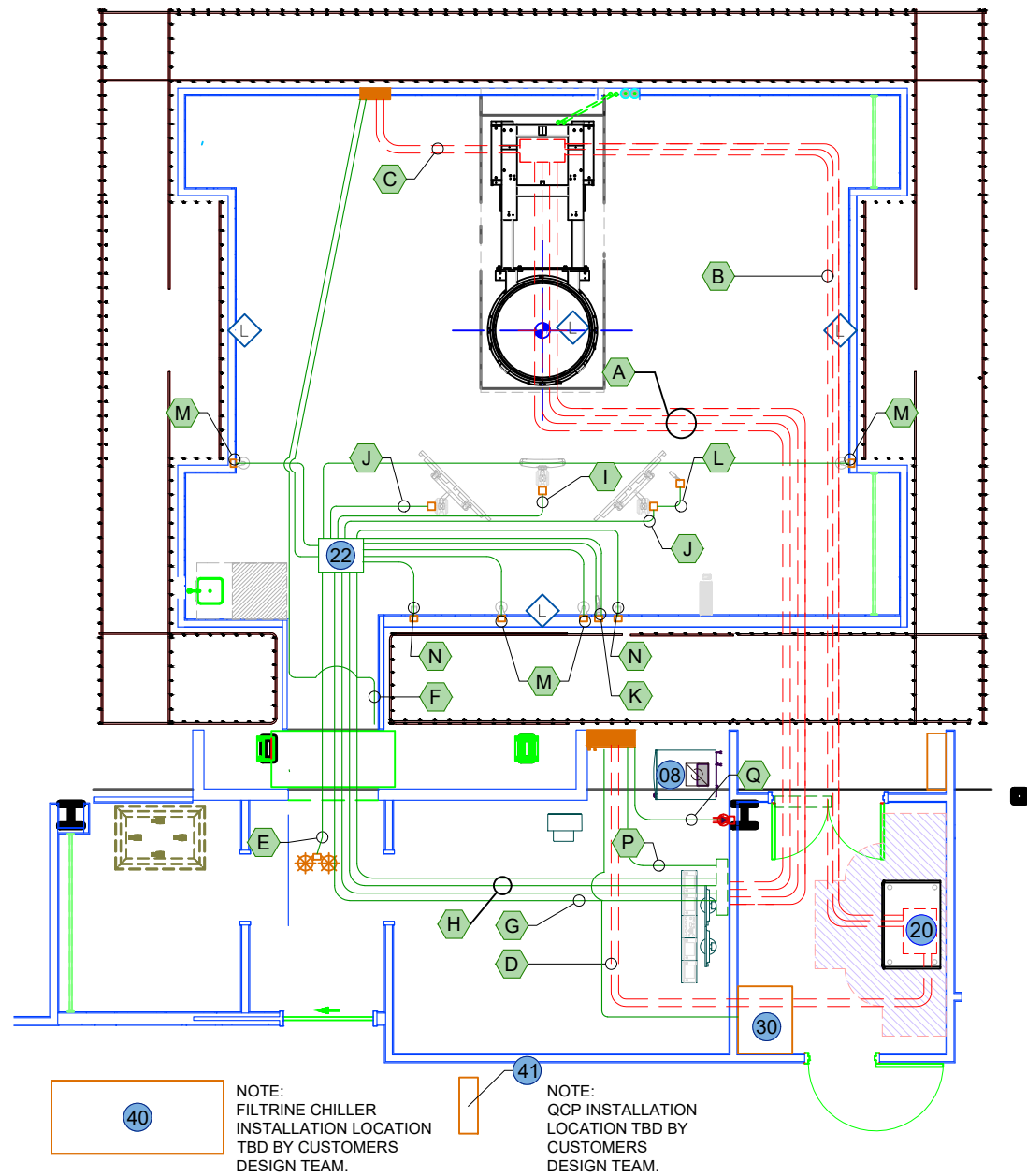
Standard Modulator Cabinet

Scale: 3/8" = 1'-0"

REFERENCE NOTES

- A. THIS DRAWING IS NOT FOR CONSTRUCTION. ALL SITE SPECIFIC INFORMATION WAS PROVIDED BY THE CUSTOMER. VERIFY ALL EXISTING CONDITIONS IN THE FIELD.
- B. THIS DRAWING IS NOT COMPLETE. THE CURRENT PRODUCT PLANNING GUIDE (PPG) TrueBeam EDITION IS TO BE USED FOR NEW OR REMODELED THERAPY ROOM PLANNING. THE PPG PROVIDES ALL THE ESSENTIAL INFORMATION AND REQUIREMENTS FOR INSTALLATION.
- C. THE FINAL SIGNED SALES ORDER WILL DETERMINE THE ITEMS FURNISHED BY VARIAN. THE CUSTOMER SIGNED SALES ORDER WILL TAKE PRECEDENCE OVER ANY ITEMS REPRESENTED IN THIS DRAWING.

TrueBeam Equipment Coordination Drawing for CENTRAL HARNETT HOSPITAL/ CAPE FEAR VALLEY HEALTH SYSTEM LILLINGTON, NC					
DRAWN BY C.LINARES	DATE 11 SEP 2023	APPROVED BY #	DATE	APPROVED BY	DATE
DIMENSIONS: ft - in [mm] NOT FOR CONSTRUCTION © 2023, Varian Medical Systems, Inc.					PAGE OF 3 8
varian		B	23-004699	EC0	REV.



40 NOTE: FILTRINE CHILLER INSTALLATION LOCATION TBD BY CUSTOMERS DESIGN TEAM.

41 NOTE: QCP INSTALLATION LOCATION TBD BY CUSTOMERS DESIGN TEAM.

TrueBeam Conduit Plan
Scale: 1/8" = 1'-0"

AB-SLAB CONDUIT ————
IN-SLAB CONDUIT - - - - -

NOTE: The Varian-supplied system cables are NOT plenum rated. Varian cables installed in a plenum space must be in conduit, duct, or raceway rated for this application per local and/or NEC (300.22) code. All cable conduit, duct, or raceway is to be provided by the customer/contractor.

TO MAIN POWER DISTRIBUTION

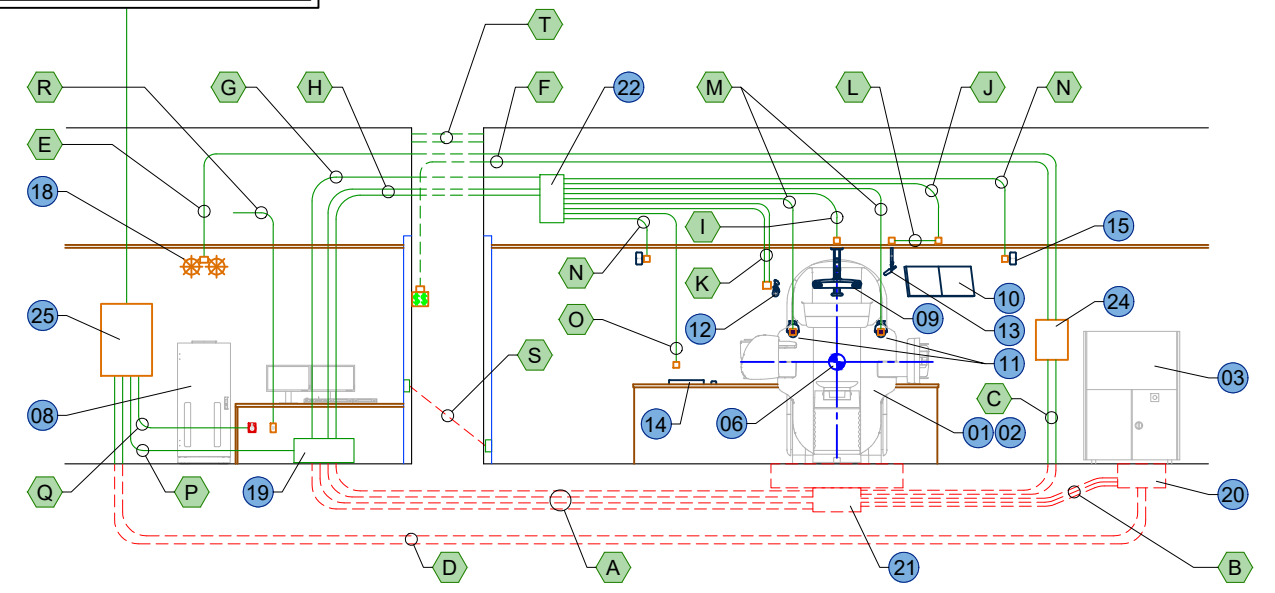
30

OPTIONAL SINGLE VOLTAGE INPUT, SINGLE VOLTAGE OUTPUT POWER CONDITIONER

GENERAL TrueBeam POWER SPEC:
• 480V, 80A, at 60Hz
• 3PH + N & G. 48KVA
FOR COMPLETE POWER SPEC SEE THE TrueBeam PPG.

TrueBeam Conduit Schedule				
FROM	TO	Qty	Size in. [mm]	X
BaseFrame Pull Box	Control Equipment Pull Box	4	4" [100]	A
	Modulator Pull Box	3	4" [100]	B
	Relay Junction Box	2	2" [50]	C
Modulator Pull Box	Main Circuit Breaker Panel	2	2" [50]	D
	Warning Lights	1	0.5" [13]	E
Relay Junction Box	Door Interlocks (24VDC & 120VAC)	1	0.5" [13]	F
	Control Equipment Pull Box	1	3" [75]	G
Accessory Pull Box	Control Equipment Pull Box	2	2" [50]	H
	Optical Imaging Camera	1	3" [75]	I
	In-Room Monitors (qty 1 set)	1	2" [50]	J
	Live View Camera & Microphone (primary)	2	1.25" [32]	K
	Microphone (secondary, ceiling)	1	1.25" [32]	L
	CCTV Camera (qty 2)	1	1" [25]	M
	Speaker (qty 2)	1	1" [25]	N
	Service Keyboard & Optional VVS System	1	1" [25]	O
	Control Equipment Pull Box	1	2" [50]	P
Main Circuit Breaker Panel	IEC 60309, 30A, 250V Receptacle	1	Per Code	Q
Network (Data)		1	1" [25]	R
Experimental (Physics) Access	Treatment Room	1	3" [75]	S
Control Area	Treatment Room (future use, optional)	2	4" [100]	T

TrueBeam Components	
(X)	EQUIPMENT
01	Stand
02	Gantry
03	Modulator Cabinet
06	Isocenter
08	Control Cabinet, 2-1 Configuration (5'-1 7/16"H x 2'-2 7/16"W x 2'-9 7/16"D)
09	Optical Imaging Camera
10	In-Room Monitors
11	CCTV Camera
12	Live View Camera w/Mic
13	Microphone (ceiling)
14	Wireless Keyboard/Mouse
15	Speaker
18	Warning Lights (Qty:2) Beam-On & X-Ray-On, verify additional requirements with the regional regulatory agency
19	Control Console Pull Box (size may vary, 30"W x 12"T x 6"D min.)
20	Modulator Pull Box
21	BaseFrame Pull Box
22	Accessory Pull Box (size may vary, 24"W x 18"L x 12"D min.)
24	Relay Junction Box (20"H x 16"W x 6"D)
25	Main Circuit Breaker Panel (37 1/4"H x 25 1/2"W x 9 1/4"D, 179 lbs.)
30	Transtector Power Conditioner (66"H x 29"W x 36"D, 1,142 lbs.)



Typical TrueBeam Conduit Riser Diagram
Scale: 1/8" = 1'-0"

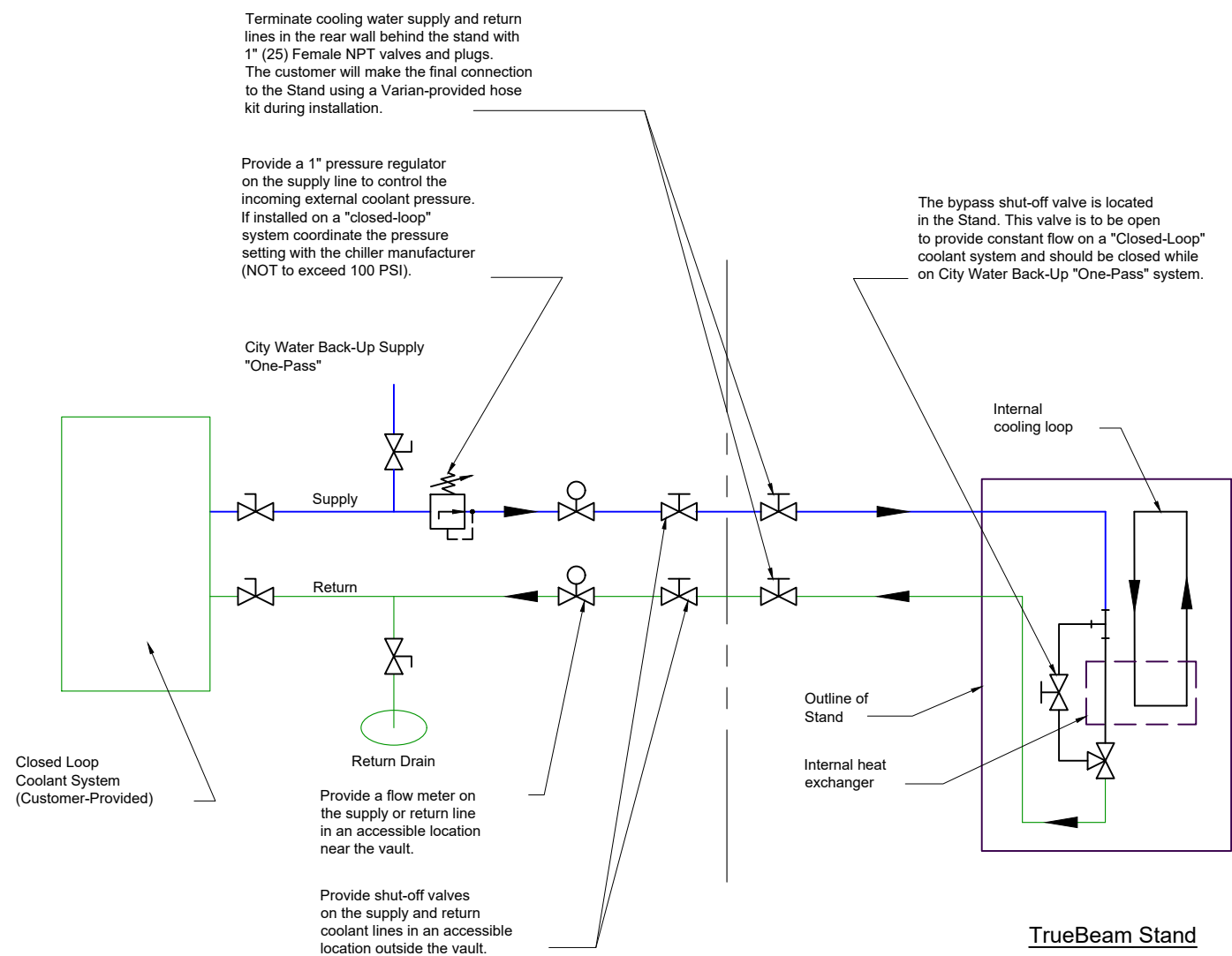
Provide adequate clearance for typical conduit radius of six times the diameter. Conduit bends shall not exceed 270 degrees per cable run. Route all room penetrations as perpendicular to the isocenter as possible to avoid radiation scatter. Verify all room penetrations with the Physicist of Record.

Conduit run lengths for Varian supplied cables shall not exceed 75'-0"

REFERENCE NOTES		DESCRIPTION OF CHANGE	TrueBeam Equipment Coordination Drawing for CENTRAL HARNETT HOSPITAL/ CAPE FEAR VALLEY HEALTH SYSTEM LILLINGTON, NC			
A.	THIS DRAWING IS NOT FOR CONSTRUCTION. ALL SITE SPECIFIC INFORMATION WAS PROVIDED BY THE CUSTOMER. VERIFY ALL EXISTING CONDITIONS IN THE FIELD.		DATE	DATE	APPROVED BY	DATE
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		REV				
		DIMENSIONS: ft - in [mm] NOT FOR CONSTRUCTION © 2023, Varian Medical Systems, Inc.				
					PAGE 4 OF 8	
		SIZE	B	23-004699	EC0	
		DRAWING NO.	REV.			

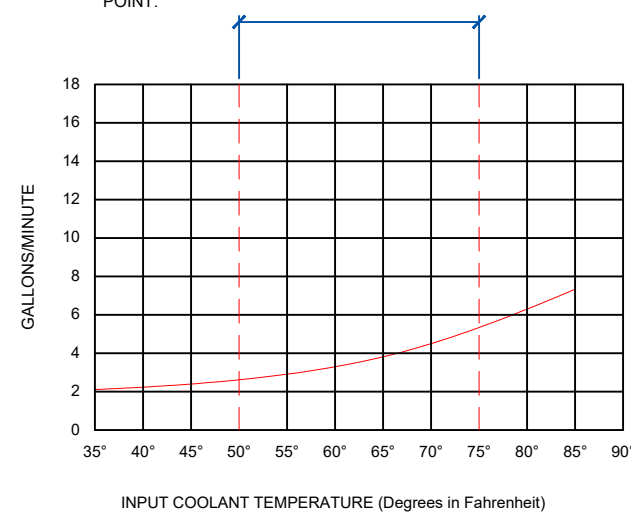
Ideal Mechanical Specifications	
Coolant Flow	65° F. @ 4 GPM (18° C. @ 15 LPM)
Glycol Content (Coolant)	Not to Exceed 50%
Compressed Air	Not Required for TrueBeam, recommend keeping if existing, relocate with water lines
Room Temperature	70° F. (21° C.)
Room Humidity	50% Relative Humidity, Non-Condensing

Treatment Vault HVAC Requirements	
Stand and Gantry (Beam-On)	7.25 kW (24,760 Btu/hr)
Modulator (Beam-On)	5.25 kW (17,930 Btu/hr)
NOTE: TrueBeam will produce detectable levels of ozone under certain conditions. Four to six air changes per hour are normally required to maintain undetectable levels. The ventilation system should use fresh-air as part of its design.	
Control Area HVAC Requirements	
2-1 Control Cabinet	1.1 kW (3,770 Btu/hr)



TrueBeam Coolant System Diagram

CHILLED WATER REQUIREMENT TO COOL THE ACCELERATOR: 3 to 6 GALLONS/MINUTE @ 50° to 75° F. DESIGN THE SYSTEM TO ELIMINATE CONDENSATION ON THE PIPING. CONSULT A PSYCHROMETRIC CHART TO DETERMINE THE DEW POINT IN THE FACILITY. EQUIPMENT DAMAGE COULD RESULT IF THE INLET COOLING TEMPERATURE IS AT OR BELOW THIS DEW POINT.



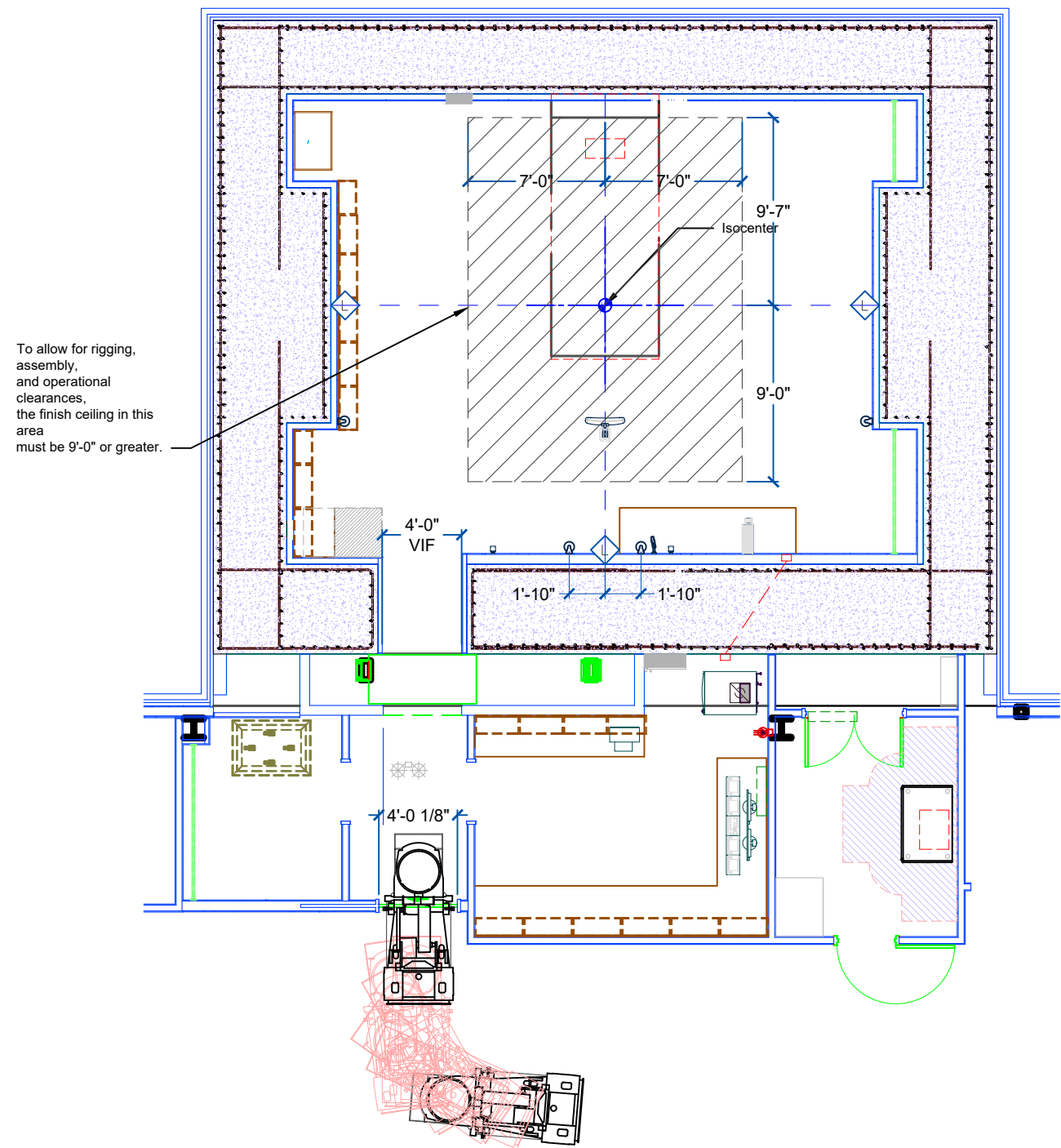
FOR THE COMPLETE COOLING WATER AND HVAC SPECIFICATION SEE THE PRODUCT PLANNING GUIDE, SECTIONS 3.3 & 3.4

Coolant Flow Requirement

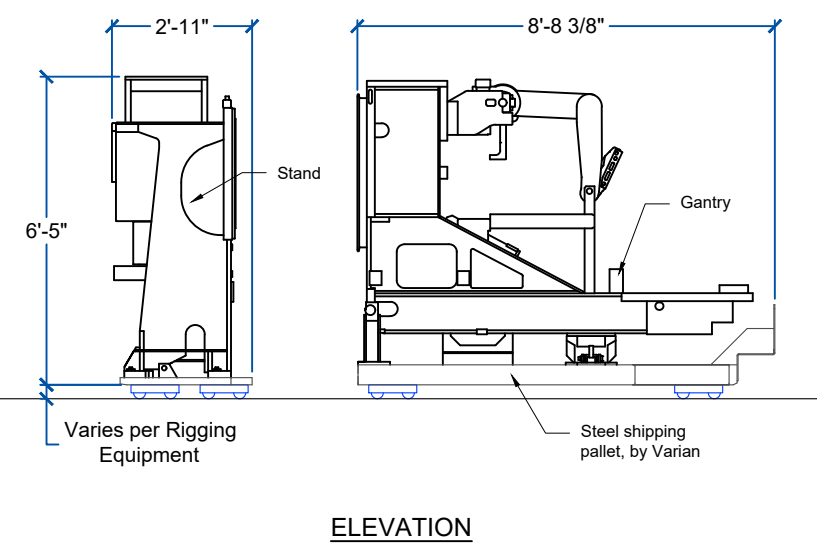
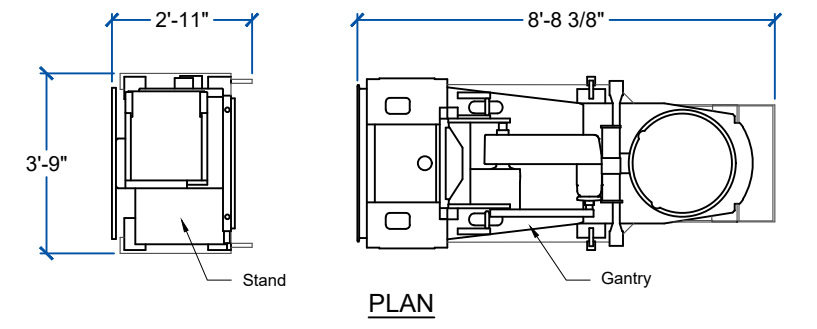
TrueBeam Coolant Requirements	
Minimum Heat Load	2 kW (6,830 Btu/hr)
Maximum Heat Load (Beam-On)	25 kW (85,379 Btu/hr)
Maximum Input Pressure (including normal back pressure)	100 PSIG (7 kg/cm ²)
The Pressure Differential between the inlet and outlet fittings in the Stand will be adjusted in the Ready State between	10 PSI (0.7 kg/cm ²) and 20 PSI (1.4 kg/cm ²) @ 3.0-5.0 GPM (11.4-18.9 LPM)
The Pressure Drop through the TrueBeam under Maximum Heat Load	24 PSI (1.7 kg/cm ²)
Average Water Temperature Rise (w/closed bypass valve)	27° F. (15° C.)

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NOTE:
 1. Verify the department floor plan has proper rigging clearances from unloading area to the Treatment Room. See DDR chapter 2 for appropriate turning radii. Verify rig path is on grade. Machine rig weight is 12,671 lbs.
 2. Verify vault door (and all door openings affiliated with Rig Path) has clear finish dimensions of 4'-0"W x 7'-0"H for proper rigging clearances.
 3. Coordinate the availability of approximately 250 sq. feet of securable storage for staging the machine during installation. Neither the vault nor the control area can be used for staging.



TrueBeam Simplified Rigging Path
 Scale: 1/8" = 1'-0"



Stand Weight: 3,240 lbs. [1470 kgs.]
 Gantry Weight: 9,431 lbs. [4278 kgs.]

Factory Break Shipping Configuration
 Scale: 1/4" = 1'-0"

- NOTES:
- During installation, TrueBeam components must be stored in a secure area of about 250 square feet (23 square meters).
 - Rigging is defined as the positioning of the BaseFrame and Linear Accelerator components into the treatment room. The BaseFrame is rigged prior to the rest of the equipment and delivery must be scheduled by the construction Contractor with the Installation Project Manager. As designated in the final Varian/Customer Terms and Conditions of Sale, a rigging company is hired by the Customer or Varian to off-load these items from the truck and to move them through the facility and into the treatment room.
 - Varian will review the installation route upon request. Coordinate all rigging with the Installation Project Manager. Final confirmation of rig route clearances and review of adequate structural support along the route is the responsibility of the Customer and the Structural Engineer of Record. The rigging preparation work can include temporary demolition and shoring. Final equipment positioning is part of the rigging contract.
 - Dimensions shown are based on the drawings provided. Actual field measurements must be verified.

REFERENCE NOTES		TrueBeam Equipment Coordination Drawing for CENTRAL HARNETT HOSPITAL/ CAPE FEAR VALLEY HEALTH SYSTEM LILLINGTON, NC					
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DATE		B	23-004699	EC0			
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LANDAUER[®]

MEDICAL PHYSICS

October 3, 2023

Shannon Jackson, Medical Imaging
Harnett Health Orthopaedics and Sports Medicine Lillington
800 Tilghman Dr
Dunn, NC 28334
Telephone: (910) 766-7061
Email: sjackson52dbb@capefearvalley.com

RE: DIAGNOSTIC X-RAY ROOM SHIELDING DESIGN REPORT

Dear Ms. Jackson,

Enclosed please find the shielding design report for the Sedecal A-6284-00 x-ray installation located at 225 Brightwater Dr., Lillington, NC 27546.

- **Please review the report carefully to ensure all submitted information was correctly interpreted and to notify us of any revisions that need to be addressed.**
- We have filed a copy of the report with the North Carolina Department of Health and Human Services, Radiation Protection Section, on your behalf and you should receive correspondence from that agency shortly regarding approval and registration.
- Landauer's recommendations are based upon the state regulations: *North Carolina Administrative Code, Title 10A, Chapter 15*
- The state regulations are available for review on the following website address: www.ncradiation.net
- Retain a copy of the report to document the calculated shielding required to meet dose limits prescribed in 10A NCAC 15 .1604 & .1611.
- **10A NCAC 15 .1603 requires facilities to develop, document, and implement a Radiation Protection Program.**

If you would like assistance with **post-installation radiation survey requirements** and/or with developing a **site-specific Radiation Protection Program**, please request a quote by contacting our team of Shield Design Coordinators at (888) 831-4880 Option 3 or by emailing them at shieldingdesign@landauermp.com. They are also available to answer any other questions you may have with this Shield Design Report.

Thank you for choosing Landauer Medical Physics as your radiation protection service provider.

Sincerely,



Scott C. Pangburn, BS, RT(R)(T)(QM)
Medical Physicist Associate
LANDAUER Medical Physics

“LANDAUER is here to help you as your resource for radiation safety services!!”

PLAN REVIEW SHIELDING REPORT

Shielding Recommendations: Sedecal A-6284-00

Wall Section	Protected Area	Type	LMP Recommended Shielding (See Notes 1)
A-B-C	Toilet	SU	1/32" Lead
C-D	Alrgy Mix	SU	1/32" Lead
E-F	Operator	SC	1/16" Lead Wall and 1/16" Lead Equivalent Glass Window
F-G	Corridor	SU	1/16" Lead
G-H	Primary Barrier	SU	3/32" Lead
H-I	Corridor	SU	1/16" Lead
I-J-K	Alcove	SU	1/32" Lead
K-A	Corridor	SU	1/32" Lead Wall and 1/32" Lead Door
Ceiling	Occupied Space	SU	Existing 3.5" Concrete is Adequate
Floor	Medical Office	PU	Existing 3.5" Concrete is Adequate

P = primary barrier; S = secondary barrier; C = controlled area; U = uncontrolled area; OF = occupancy factor

Sedecal A-6284-00 Calculation Parameters

Imaging Type	N weekly (total)	Workload (mA-min/week)	kVp
Rad	150	375	120

Additional Variables & Calculated Transmission

Wall Section	Distance (m)	P _{Design Goal} (mR/week)	Occupancy Factor T	K _{sec} (0) (mR/week)	* Transmission Factor B(x) _{barrier}
A-B-C	2.7	2	0.200	79.74	0.1254
C-D	3.5	2	1.000	49.72	0.0402
E-F	2.2	2	1.000	125.10	0.0160
F-G	1.5	2	0.200	89.70	0.1115
G-H	2.1	2	0.200	1354.00	0.0074
H-I	1.7	2	0.200	217.40	0.0460
I-J-K	2.7	2	0.200	78.44	0.1275
K-A	3.8	2	0.200	38.91	0.2570
Ceiling	2.2	2	1.000	125.1	0.0160
Floor	1.8	2	1.000	90.83	0.0220

Design dose limits: Uncontrolled - 2 mrem/week (100 mrem/year); Controlled - 10 mrem/week (500 mrem/year)

* NCRP 147 Transmission Factor, B(x):

$$B_{sec}(X) = (P/T) * d_{sec}^2 / (K_{sec}^1 * N) = (P/T) / K_{sec}(0)$$

Definition of Terms

N_{weekly} – number of patients per week

$K_{\text{sec}}(0)$ – total weekly unattenuated air kerma at point of interest from source for all patient exposures

Distance – total distance from scatter object to the area of concern (distance to wall plus 1 foot) for secondary scatter; primary beam distance is the distance from the tube to the area of concern (distance to wall plus 1 foot)

T – Occupancy factor (hours per week a person spends in the protected area)

P_{week} – Design Goal or exposure limit per week

$B(x)$ – radiation transmission through a given barrier material (x)

Table Notes and Additional Information

- **IMPORTANT** - This plan review is specific for the information provided by the requestor. Any changes in equipment, room layout, occupancy of adjacent areas, changes in x-ray workload, upgrades to additional imaging modalities, changes in field size of imaging receptors, or any other condition that may contribute to an increased risk of radiation exposure will require re-evaluation of the shielding by a qualified physicist. If there are any doubts about what may constitute a change, please contact LANDAUER Medical Physics.
- **Note 1** - Areas beyond the immediate adjacent space to the barrier of interest have been considered when determining shielding recommendation.
- The recommended shielding is the total thickness of specified material needed to reduce the radiation dose below regulatory limitations.
- Prior to construction of all new installations, or modifications of existing installations, or installation of equipment into existing facilities utilizing X-rays for diagnostic or therapeutic purposes, the floor plans and equipment arrangements shall be submitted to the agency for review and verification that national standards have been met.
- *Regulatory Note: For stationary x-ray systems, the control shall be permanently mounted in a protected area so that the operator is required to remain in that protected area during the entire exposure. {NC Administrative Code 10A 15.0606(b)(2)(B)(1)}*
- **Door to the exposure room is closed during x-ray production.**
- **Wall shielding must extend from the finished floor to a height of 84”.**
- All shielded barriers, including view windows and frames, doors and door frames, should be of the specified shielding equivalencies or greater and should have no voids.
- Any penetrations in the shielding should be designed to afford the same shielding equivalency as specified for that barrier.
- Penetrations in the shielding (electrical boxes, cables, fasteners, etc.) should be secured in place with mechanical fasteners or by welding. Metal screws do not require lead caps and the use of tapes, adhesives or plastic materials as a fastener is not recommended.

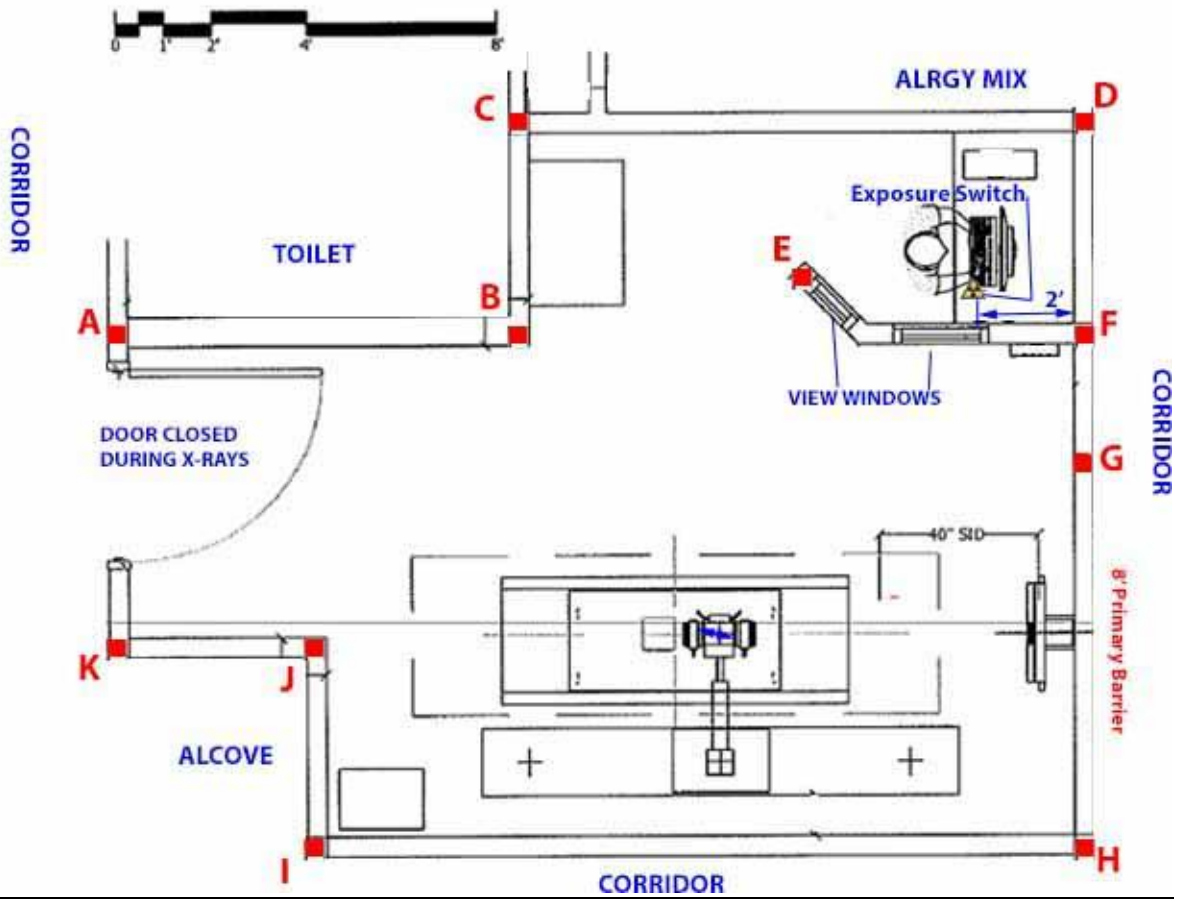
- Landauer Medical Physics performs transmission calculations based on the information provided by the requestor's Shield Design application and cannot be held responsible for errors in shielding requirements due to inaccurate information.
- These shielding specifications have been prepared in accordance with guidelines set forth in National Council on Radiation Protection and Measurements Report 147, and NC Administrative Code.
- The state agency reserves the right to impose additional requirements, as it deems appropriate or necessary to minimize danger to public health, safety or property.

Shielding Calculations Submitted by:



Scott C. Pangburn, BS, RT(R)(T)(QM)
Medical Physicist Associate
LANDAUER Medical Physics

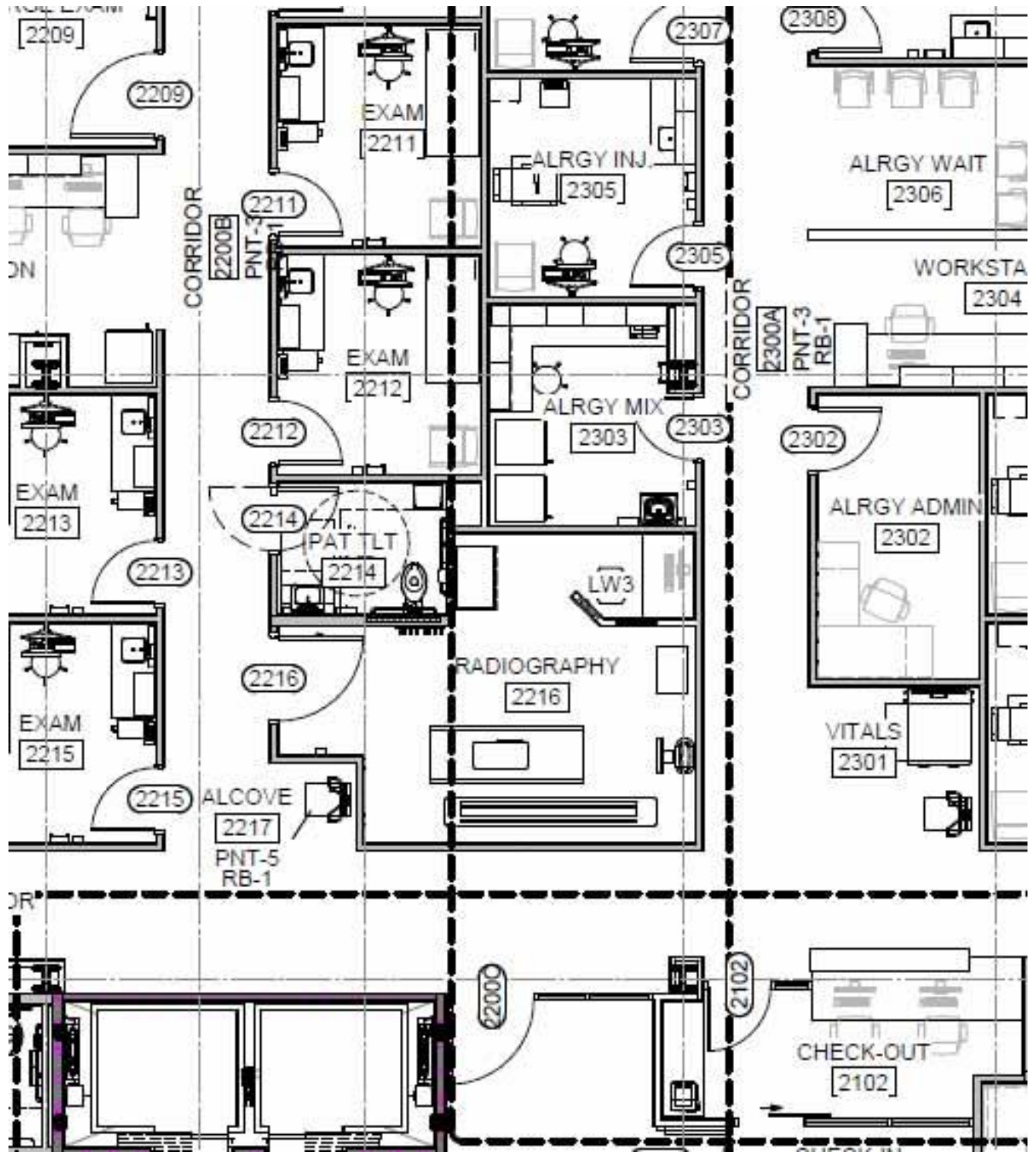
X-Ray Room



Shielding Recommendations: Sedecal A-6284-00

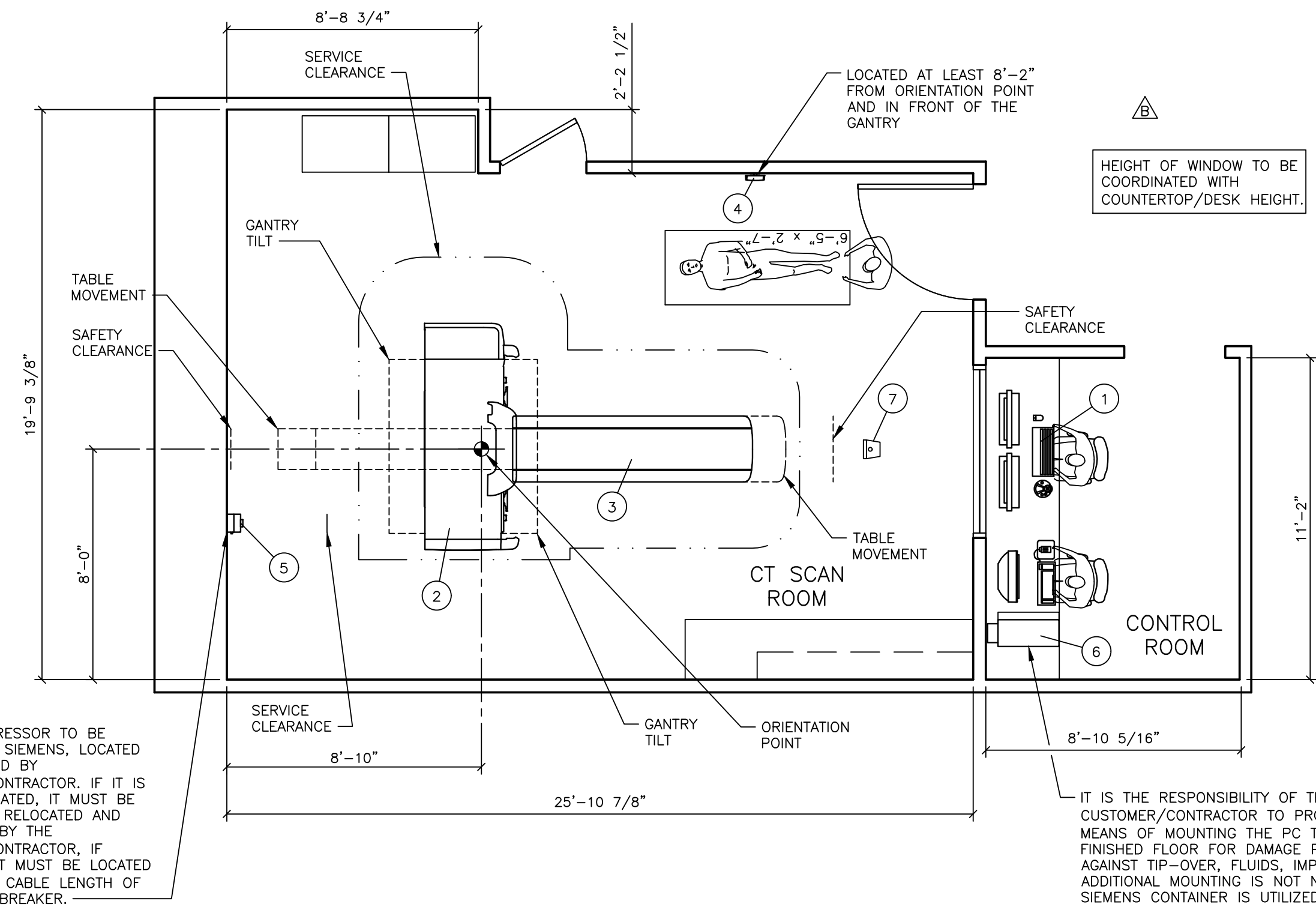
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C-D	Alrky Mix	Wall	1/32" Lead
E-F	Operator	Wall/Window	1/16" Lead Wall and 1/16" Lead Equivalent Glass Window
F-G	Corridor	Wall	1/16" Lead
G-H	Primary Barrier	Wall	3/32" Lead
H-I	Corridor	Wall	1/16" Lead
I-J-K	Alcove	Wall	1/32" Lead
K-A	Corridor	Wall/Door	1/32" Lead Wall and 1/32" Lead Door
Ceiling	Occupied Space	Ceiling	Existing 3.5" Concrete is Adequate
Floor	Medical Office	Floor	Existing 3.5" Concrete is Adequate

Client Submitted Drawing



THIS SET OF FINAL DRAWINGS IS REFLECTIVE OF THE LATEST SALES CONFIGURATION. ANY CHANGES TO THIS SALES CONFIGURATION MAY REQUIRE A REVISION TO THIS PROJECT PLAN. IF REQUESTED, SIEMENS WILL PRODUCE A REVISED SET OF FINAL DRAWINGS TO REFLECT THE CHANGES. HOWEVER SIEMENS IS NOT RESPONSIBLE FOR ANY CONSTRUCTION COSTS ASSOCIATED WITH THE CHANGES THAT OCCUR FROM THIS PLAN MODIFICATION.

STRETCHER SIZE (6'-5" X 2'-7") SHOWN IS FOR REFERENCE ONLY. VERIFICATION AND COORDINATION BY CUSTOMER IS REQUIRED TO ENSURE PROPER TRANSPORT AND WORKFLOW ACCESS.

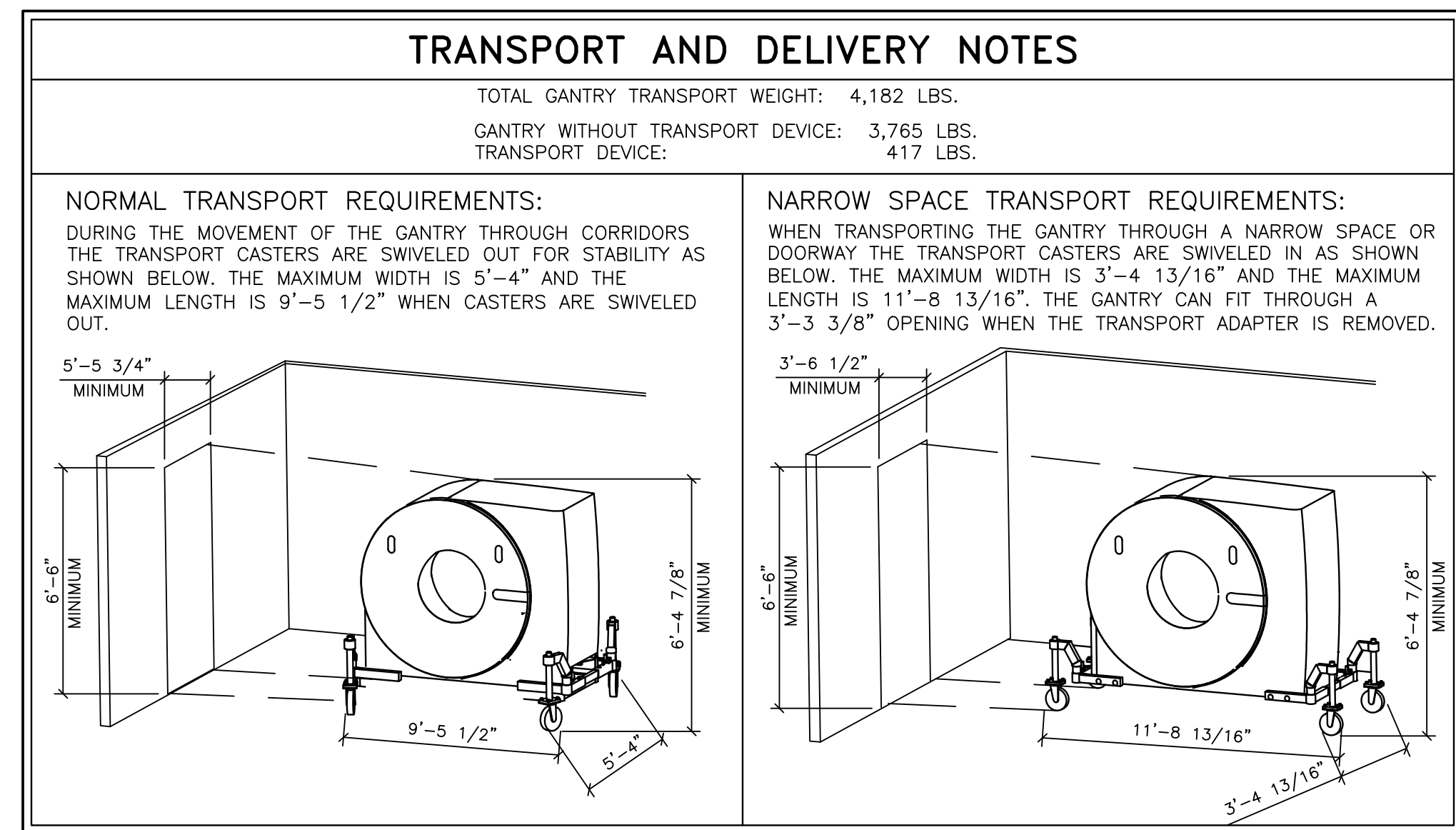


HEIGHT OF WINDOW TO BE COORDINATED WITH COUNTERTOP/DESK HEIGHT.

IT IS THE RESPONSIBILITY OF THE CUSTOMER/CONTRACTOR TO PROVIDE A MEANS OF MOUNTING THE PC TOWER(S) OFF FINISHED FLOOR FOR DAMAGE PROTECTION AGAINST TIP-OVER, FLUIDS, IMPACT, ETC. ADDITIONAL MOUNTING IS NOT NECESSARY IF SIEMENS CONTAINER IS UTILIZED.

ARCHITECTURAL EQUIPMENT PLAN

SCALE: 1/4" = 1'-0"



ENVIRONMENTAL CONDITIONS

AIR TEMPERATURE	MINIMUM 64.4°F TO 86°F MAXIMUM
RELATIVE HUMIDITY	20% TO 75%
ABSOLUTE HUMIDITY	MAXIMUM 30 G/M ³ (NO CONDENSATION AT ANY TIME)
TEMPERATURE GRADIENT	MAXIMUM 6 KELVIN PER HOUR
BAROMETRIC PRESSURE	11.6 TO 15.4 PSI
INSTALLATION ALTITUDE	MAXIMUM 6562 FT. A.S.L

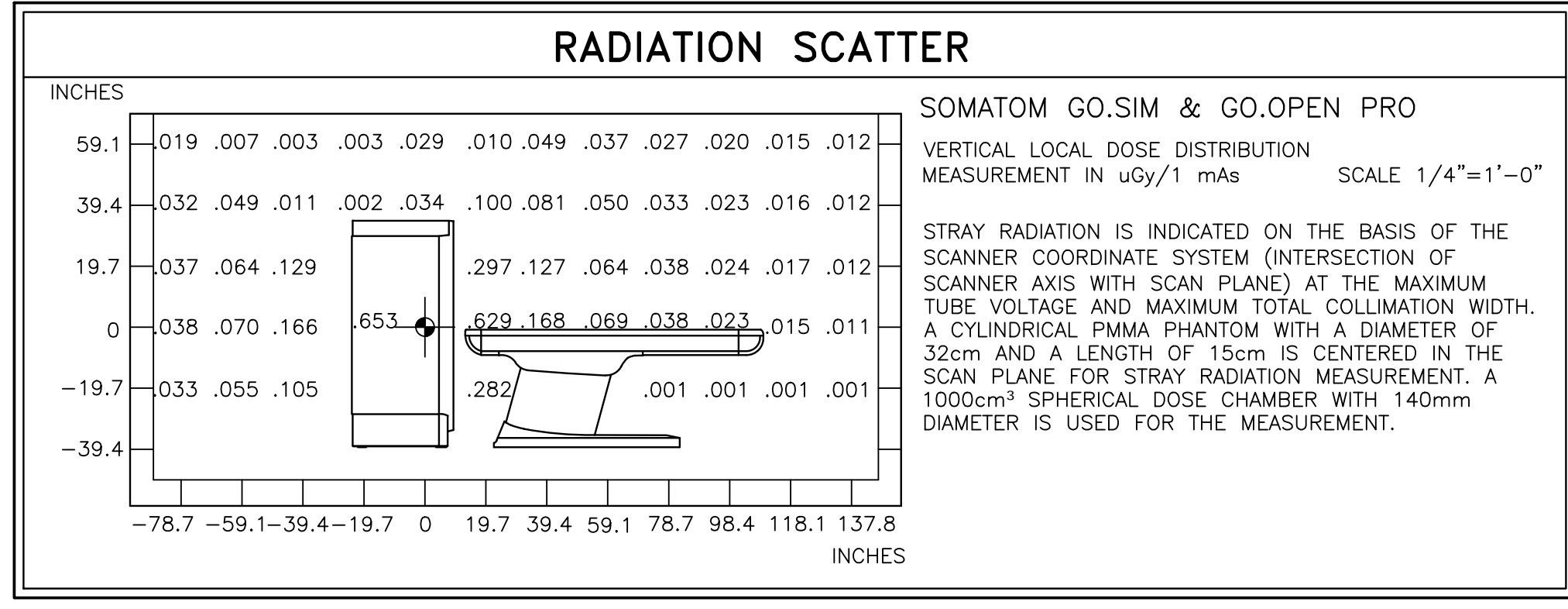
EXTERIOR AIR VENTS SHOULD BE EQUIPPED WITH A FILTRATION SYSTEM OF THE FILTER CLASS MERV 8 TO FILTER DUST PARTICLES >10 µm.

THE ROOM AIR SHOULD BE PROTECTED AGAINST CONTAMINATION BY HYDROGEN SULPHIDE, EVEN IN SMALL AMOUNTS. IF A DANGER OF SUCH CONTAMINATION EXISTS, CORRECTIVE ACTIONS HAVE TO BE TAKEN. E.G., EXTRACTOR FANS, SIPHON, MODIFICATION OF VENTILATION INTAKE, ETC.

NO SUNSHINE DIRECTLY ON GANTRY. INSULATION HAS TO BE APPLIED TO WINDOW (EX. CURTAIN)

EQUIPMENT LEGEND

NO	DESCRIPTION	SMS SYM	WEIGHT (LBS)	BTU/HR TO AIR	DIMENSIONS (INCHES)			REMARKS
					W	D	H	
1	23" FLAT SCREEN DUAL MONITORS, KEYBOARD AND CONTROL DEVICE	20	20	---	22 1/2	9 1/4	19 3/8	
2	SOMATOM GO.OPEN PRO GANTRY	5	3,765	24,226	94 1/2	39 1/4	82 3/8	
3	PATIENT TABLE - VARIO 2	65	780	1,024	99 5/8	27 1/2	20 3/4	307kg. MAX. HEIGHT 38"
4	WIRELESS ACCESS POINT	40	2.5	---	---	---	---	HEIGHT OFF FF: > 6'-6 3/4"
5	EATON SURGE PROTECTIVE DEVICE PANEL	30	13.5	---	7 1/2	6 11/16	12	WALL MOUNTED
6	VARIAN RGSC WORKSTATION CABINET, MONITOR, KEYBOARD	25	---	---	---	---	---	
7	VARIAN RGSC CAMERA - CEILING MOUNTED	24	4.5	---	---	---	---	SEE DETAIL S-101/S-102



Project Milestones To Be Completed Before Equipment Delivery	Reference Sheet
<input type="checkbox"/> Lead shielding (walls, doors, windows) complete	A-101/A-102
<input type="checkbox"/> Climate control functioning 24 hours a day, 7 days a week	A-101
<input type="checkbox"/> Delivery path verified	A-101
<input type="checkbox"/> Casework complete in exam and control rooms	A-101
<input type="checkbox"/> Floor levelness verified and within specifications	S-101/S-501
<input type="checkbox"/> Floor thickness verified and within specifications	S-101/S-501
<input type="checkbox"/> All conduits, troughs, and core drills are outside of the No Core Drill areas	E-102/E-501
<input type="checkbox"/> Carevision anchor plate installed (if applicable)	S-102
<input type="checkbox"/> Overhead injector support structure and plate installed (if applicable)	S-102
<input type="checkbox"/> Ceiling height verified (check min. height with options)	S-102
<input type="checkbox"/> Cables runs checked to ensure maximum length is not exceeded	E-101
<input type="checkbox"/> Cables inlets installed at locations per plans	E-101/E-102
<input type="checkbox"/> Main panel and breakers installed	E-101/E-102
<input type="checkbox"/> Contractor supplied electrical cabling and pigtailed installed	E-101/E-102
<input type="checkbox"/> Contractor supplied EPO's installed and functioning	E-102/E-501
<input type="checkbox"/> Contractor supplied X-Ray warning light and wiring installed	M-101
<input type="checkbox"/> Outdoor chiller unit and service switch installed (water/air option) (if applicable)	M-101
<input type="checkbox"/> Indoor chiller unit installed (water/air option) (if applicable)	M-101
<input type="checkbox"/> Water lines flushed and pressure tested (for hard-piping only) (if applicable)	M-101
<input type="checkbox"/> Additional fittings/adapters ordered for hard piping (water/air option) (if applicable)	M-101
<input type="checkbox"/> Vertical distance between indoor and outdoor unit verified (water/air option) (if applicable)	A-101
<input type="checkbox"/> Extension cables installed for chiller if standard distance exceeded between indoor and outdoor units (water/air option) (if applicable)	M-101
<input type="checkbox"/> Facility water verified to meet equipment requirements (Facility supplied water option) (if applicable)	M-101
<input type="checkbox"/> Room lighting complete and functioning	A-101
<input type="checkbox"/> All rooms containing Siemens equipment are clean and dust free	A-101
<input type="checkbox"/> Network addresses obtained for Siemens Remote Services (SRS)	A-102/E-501

PLANNING REQUIREMENTS

EMERGENCY POWER OFF (EPO) BUTTONS ARE REQUIRED IN CONTROL AREA AND AT LEAST ONE LOCATION IN EXAMINATION OR SCAN ROOM.

DOOR (SAFETY) SWITCHES ARE REQUIRED ON ALL DOORS ACCESSING THE EXAMINATION ROOM IN ACCORDANCE WITH LOCAL CODES.

FINISHED ROOM HEIGHT

FOR CT GANTRY ONLY	MINIMUM 7'-2 5/8"
FOR CT GANTRY WITH GANTRY ARM	MINIMUM 7'-10 1/2"
CAREVISION MONITOR/CEILING MOUNT	SEE DETAIL ON S-102 SHEET

ARCHITECTURAL NOTES

- ALL PRELIMINARY EQUIPMENT LAYOUTS SUBMITTED BY SIEMENS HEALTHCARE ARE BASED ON THE RECOMMENDED SPACE NECESSARY FOR THE OPERATION AND SERVICEABILITY OF THE EQUIPMENT BEING PROPOSED. SIEMENS WILL NOT SUBMIT AN EQUIPMENT LAYOUT THAT IS NOT IN THE BEST INTEREST OF BOTH THE CUSTOMER AND SIEMENS. ALL EQUIPMENT LAYOUTS ARE BASED EITHER ON AN ACTUAL SITE SURVEY OR ARCHITECTURAL DRAWINGS SUPPLIED TO SIEMENS. SIEMENS WILL NOT BE RESPONSIBLE FOR ANY ALTERATIONS THAT ENCOACH WITHIN DESIGNATED SAFETY AND SERVICE CLEARANCE ZONES AS INDICATED ON DRAWINGS (I.E., PIPE CHASES, VENTILATION DUCTS, CASEWORK, AND SOFFITS, ETC.) MADE BY THE CUSTOMER OR REQUIRED BY A CUSTOMER'S ARCHITECTURAL FIRM ONCE PRELIMINARY DRAWINGS HAVE BEEN SUBMITTED AND APPROVED. DO NOT ALTER ANY SPECIFICATIONS AND/OR DIMENSIONS WITHOUT CONTACTING AND RECEIVING WRITTEN CONFIRMATION FROM SIEMENS PROJECT MANAGER.
- SIEMENS HEALTHCARE IS NOT AN ARCHITECTURAL OR ENGINEERING FIRM. DRAWINGS SUPPLIED BY SIEMENS ARE NOT CONSTRUCTION DRAWINGS. THEREFORE, THESE DRAWINGS ARE TO BE USED ONLY FOR INFORMATION TO COMPLEMENT ACTUAL CONSTRUCTION DRAWINGS AVAILABLE FROM A CUSTOMER APPOINTED ARCHITECTURAL REPRESENTATIVE OR A CUSTOMER'S ENGINEERING DESIGN GROUP. THE CUSTOMER'S ARCHITECT AND GENERAL CONTRACTOR SHALL BE ULTIMATELY RESPONSIBLE FOR COMPLIANCE WITH ALL APPLICABLE CODES AND PROFESSIONAL DESIGN REQUIREMENTS INCLUDING OSHA/NEC SAFETY CLEARANCE REQUIREMENTS IN ADDITION TO SIEMENS-REQUIRED SAFETY/SERVICE CLEARANCES SHOWN.
- THE CUSTOMER IS RESPONSIBLE FOR ALL ROOM AND AREA PREPARATION COSTS, PROFESSIONAL FEES, PERMITS, REPORTS, AND INSPECTION FEES.
- EQUIPMENT WARRANTIES, EXPRESSED OR IMPLIED ON THE PART OF SIEMENS SHALL BE CONTINGENT UPON STRICT COMPLIANCE WITH THE ARCHITECTURAL, STRUCTURAL, ELECTRICAL, MECHANICAL AND RECOMMENDATIONS AND REQUIREMENTS CONTAINED IN THESE DRAWINGS, UNLESS SPECIFIED OTHERWISE.
- ALL DIMENSIONS SHOWN ARE FROM FINISHED SURFACES UNLESS SPECIFIED OTHERWISE.
- THIS DRAWING DOES NOT PROVIDE RADIATION SHIELDING REQUIREMENTS FOR X-RAY AND ASSOCIATED EQUIPMENT. THE CUSTOMER IS RESPONSIBLE FOR CONSULTING WITH A REGISTERED RADIATION PHYSICIST. ACTUAL PROTECTION REQUIREMENTS SHALL BE SPECIFIED BY A REGISTERED RADIATION PHYSICIST AT CUSTOMER'S ENGAGEMENT AND EXPENSE. RESPONSIBILITY FOR ALL INFORMATION AS TO THE ROOM LOCATION, USE, AND NUMBER OF ANTICIPATED EXAMINATIONS TO BE PERFORMED PER THE PERIOD SHALL BE PROVIDED TO THE PHYSICIST BY THE CUSTOMER. THE CUSTOMER SHALL FURTHER TAKE ALL RESPONSIBILITY IN THE COMMUNICATION AND COORDINATION OF ACTIVITIES OF THE RADIATION PHYSICIST AND THE ARCHITECTURAL REPRESENTATIVE.
- SIEMENS HEALTHCARE SHALL BE RESPONSIBLE FOR SIEMENS EQUIPMENT INSTALLATION, CALIBRATION, CONNECTION AND INSTALLATION OF SIEMENS PROVIDED CABLES. THE CUSTOMER/ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR TERMINATIONS OF CUSTOMER/ELECTRICAL CONTRACTOR-SUPPLIED CABLES TO SIEMENS EQUIPMENT. IN THE EVENT THAT SPECIFIC TRADE RULES OR LICENSE REQUIREMENTS PROHIBIT THIS, THE CUSTOMER SHALL INITIATE THE SERVICES OF APPROVED OTHER CONTRACTORS AND PAY FOR SELECTED, APPROVED PARTIES TO PERFORM THIS WORK WITH SUPERVISION PROVIDED BY SIEMENS. CALIBRATION WHEN ACCOMPLISHED OUTSIDE OF NORMAL INSTALLATION SEQUENCES DUE TO CONTRACTOR OR TRADE RULE ACTIONS OR REQUIREMENTS SHALL BE SUPPORTED BY, CHARGED TO, AND ACCEPTED BY THE CUSTOMER AS AN ADDITIONAL INSTALLATION EXPENSE.
- THE CUSTOMER SHALL COORDINATE WITH SIEMENS PROJECT MANAGER THE LOCATIONS AND TRAVEL OF ALL ANCILLARY EQUIPMENT TO BE CEILING OR WALL MOUNTED (I.E., O.R. LIGHTS, MEDICAL GAS COLUMNS, PHYSIOLOGICAL MONITORING INJECTORS, CRT PLATFORMS, SPRINKLER HEADS, SMOKE DETECTORS, ELECTRICAL OUTLETS, HVAC GRILLES, SPEAKERS, AND GENERAL ROOM LIGHTING, ETC.).
- THE GENERAL CONTRACTOR/CUSTOMER SHALL BE RESPONSIBLE FOR ALL FINAL PAINT, TOUCH-UP AND ANY COSMETIC OR TRIM WORK WHICH NEEDS TO BE OR IS REQUIRED TO BE COMPLETED AFTER THE INSTALLATION OF THE SIEMENS EQUIPMENT AND ANY ASSOCIATED SUPPORT APPARATUS.
- CUSTOMER/CONTRACTOR MUST ASSIST SIEMENS INSTALLERS WITH INSTALLATION OF EQUIPMENT ABOVE 14'-0". REFER TO THE ELECTRICAL NOTES ON SIEMENS SHEET E-101 FOR MORE DETAILS.

CASEWORK & ACCESSORY NOTES

- ALL CASEWORK IS EITHER EXISTING OR IS TO BE DESIGNED, DETAILED, FURNISHED AND INSTALLED BY THE CUSTOMER AND/OR CONTRACTOR. FOLLOW DESIGN RECOMMENDATIONS INCLUDED HEREWITH, AS THEY ARE ESSENTIAL FOR THE SUCCESSFUL INSTALLATION & OPERATION OF THE SIEMENS EQUIPMENT.
- THE SOUND SYSTEM AND INTERCOM BETWEEN THE EXAMINATION AND CONTROL ROOMS ARE TO BE LOCATED, FURNISHED AND INSTALLED BY THE CUSTOMER/CONTRACTOR.
- ALL FURNITURE (CHAIRS, ETC.) FOR THE CONTROL ROOM ARE TO BE PROVIDED BY THE CUSTOMER.

STATE AGENCY REVIEW

PRIOR TO SIEMENS EQUIPMENT INSTALLATION, APPROVAL OF CONSTRUCTION OR STRUCTURAL MODIFICATIONS UTILIZING X-RAY FOR DIAGNOSTIC OR THERAPEUTIC PURPOSES, MUST BE OBTAINED BY THE CUSTOMER FROM THE APPROPRIATE STATE AGENCY, IF APPLICABLE.

RESOURCE LIST (SMS USE ONLY)

DESIGNATION	PG NUMBER	DATE
SOMATOM GO	C2-081.891.01.17.02	09.22
COMMON CT	CT00-000.891.04.22.02	06.22
COMMON CT OPTIONS	CT00-000.891.03.53.02	01.23

PROJECT MANAGER: JASON BOSWELL
TEL: (919) 368-5780
FAX: (800) 727-7156 EXT:
EMAIL: JASON.BOSWELL@SIEMENS-HEALTHINEERS.COM

SIEMENS

CENTRAL HARNETT HOSPITAL

215 BRIGHTWATER DR, LILLINGTON, NC 27546
FLOOR: GROUND/ ROOMNO: CT SIM - SOMATOM GO.OPEN PRO

PROJECT #: **2202476**
SHEET: **A-101**

THE USE OR REPRODUCTION OF THIS TITLE BLOCK WITHOUT SIEMENS AUTHORIZATION WILL RESULT IN PROSECUTION UNDER FULL EXTENT OF THE LAW.

ALL RIGHTS ARE RESERVED.
SCALE: AS NOTED REF.#: 30267651

DATE: 08/28/23
DRAWN BY: J. DRAMIS

ATTENTION:

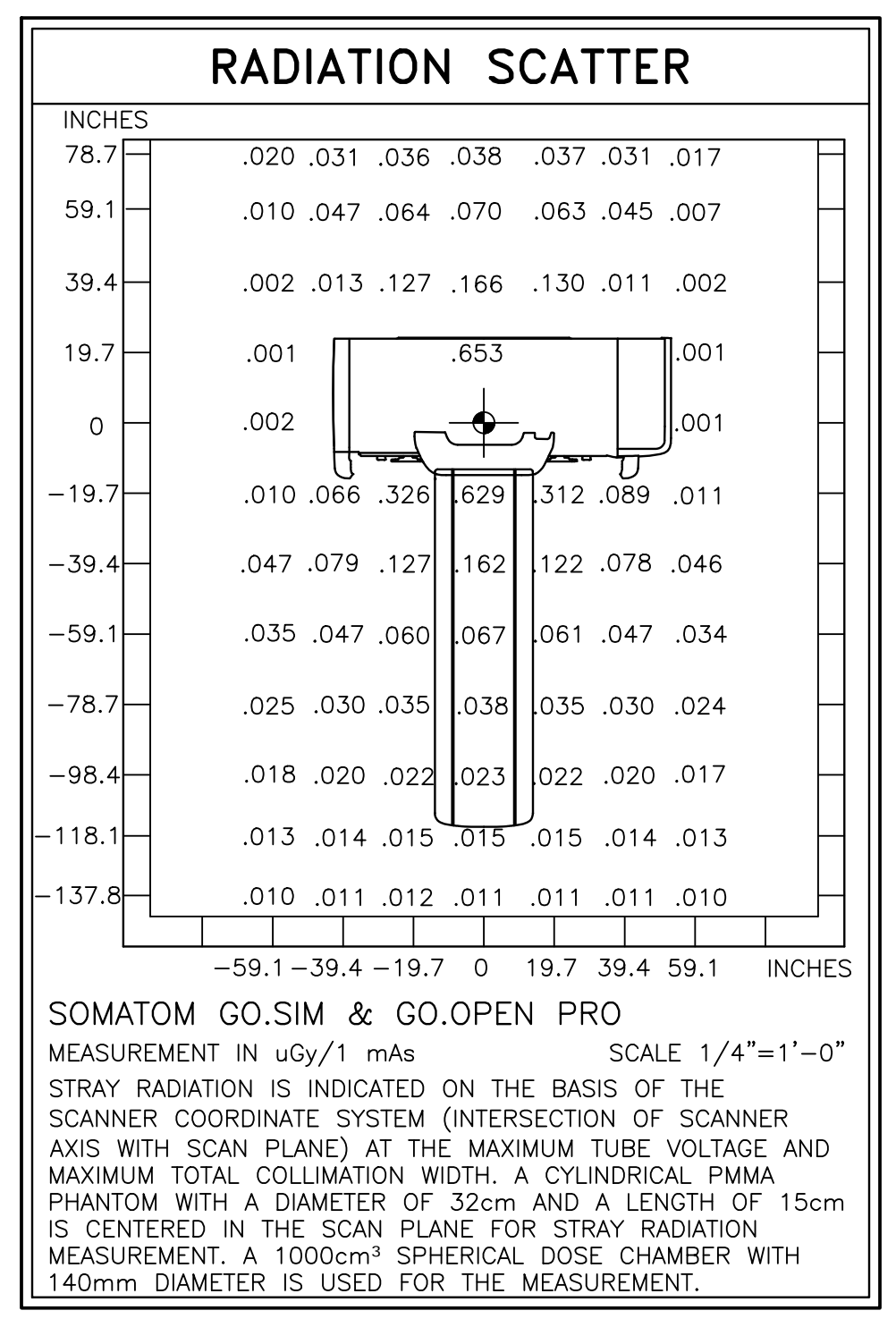
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- THIS SET OF PLANS REPRESENTS A COMPLETE SET OF DETAILS AND SHOULD NOT BE SEPARATED.

- IT IS RECOMMENDED THAT THE SIEMENS DRAWINGS BE INCORPORATED WITH THE CONSTRUCTION DOCUMENTS FOR REFERENCE.

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SYM	DATE	DESCRIPTION
08/28/23	2202476RB	DATED 08/28/23 APPROVED BY CUSTOMER FOR FINALS
-ISSUE BLOCK-		

REFERENCE DOCUMENT - NOT FOR CONSTRUCTION



GO-SIM
REV 14

PROJECT MANAGER: JASON BOSWELL TEL: (919) 368-5780 VMAIL: (800) 727-7156 EXT: FAX: EMAIL: JASON.BOSWELL@SIEMENS-HEALTHINEERS.COM			SIEMENS		
			CENTRAL HARNETT HOSPITAL		
			215 BRIGHTWATER DR, LILLINGTON, NC 27546 FLOOR: GROUND/ ROOMNO: CT SIM - SOMATOM GO.OPEN PRO		
			PROJECT #: 2202476		SHEET: A-501
THE USE OR REPRODUCTION OF THIS TITLE BLOCK WITHOUT SIEMENS AUTHORIZATION WILL RESULT IN PROSECUTION UNDER FULL EXTENT OF THE LAW.			DRAWN BY: J. DRAMIS		
ALL RIGHTS ARE RESERVED.			DATE: 08/28/23		
SCALE: AS NOTED			REF. #: 30267651		
-ISSUE BLOCK-					

ATTENTION:

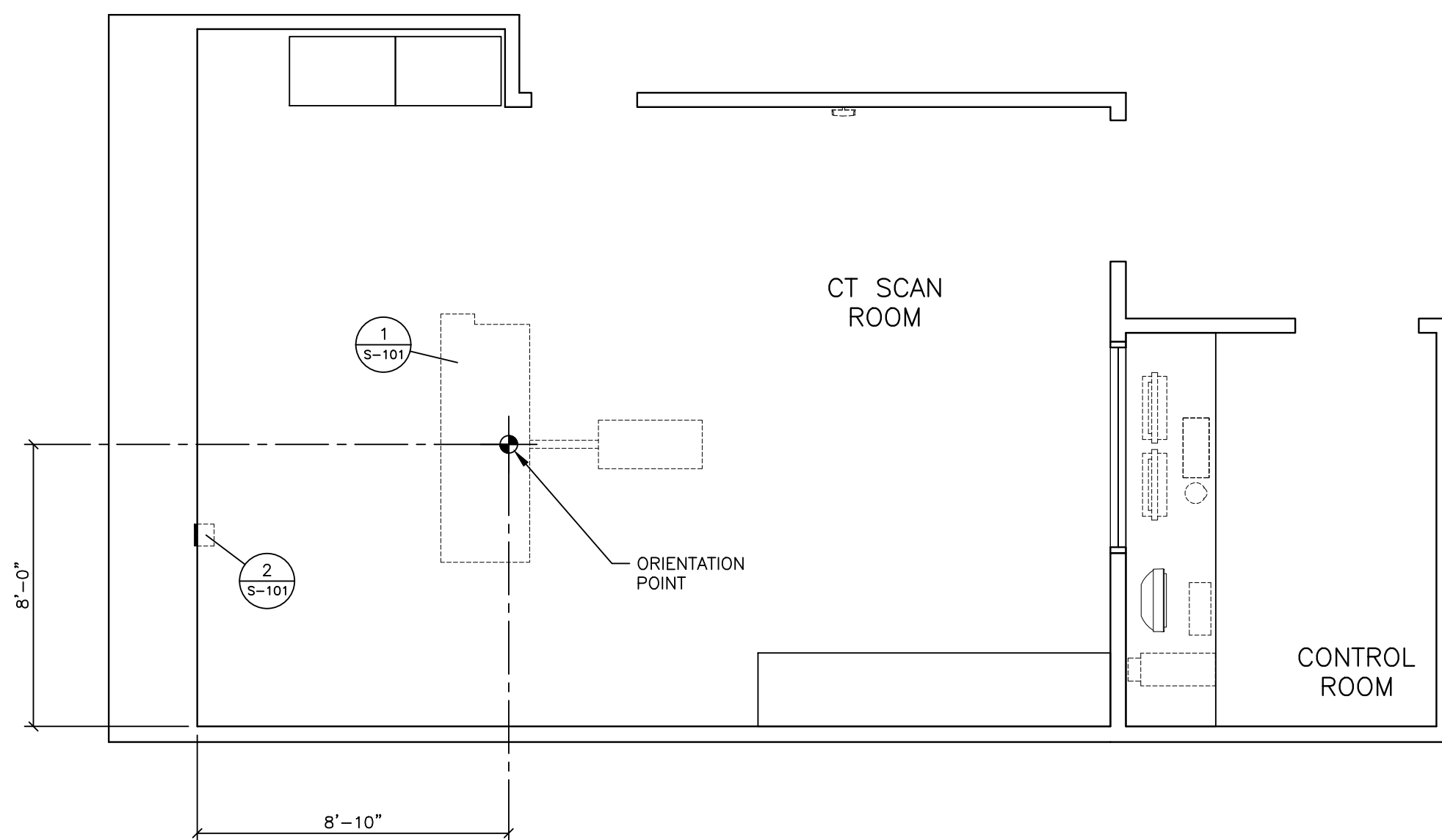
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REFERENCE DOCUMENT - NOT FOR CONSTRUCTION

NOTE: FOR THE WEIGHTS OF ALL SIEMENS EQUIPMENT SHOWN ON THIS PLAN, SEE THE "EQUIPMENT LEGEND" ON SHEET A-101.

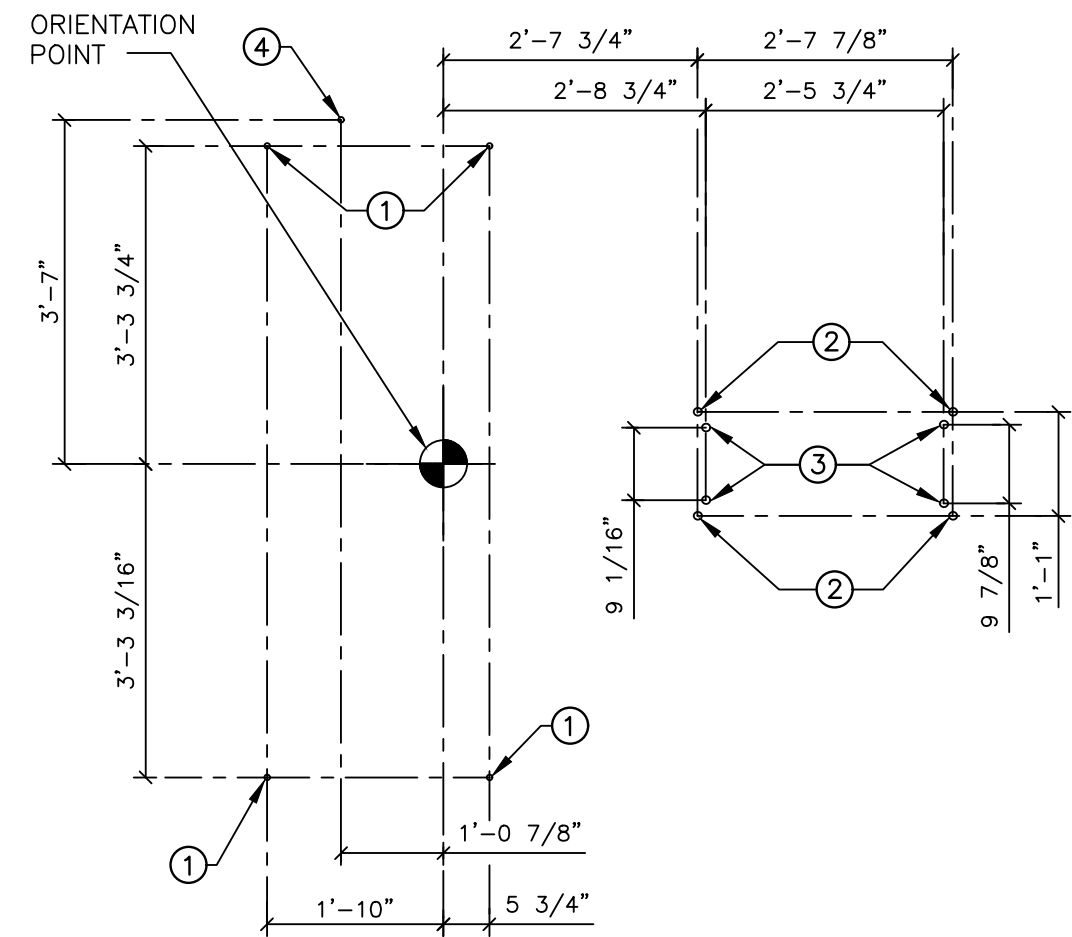


STRUCTURAL FLOOR PLAN

SCALE: 1/4" = 1'-0"

THE GANTRY AND PATIENT TABLE ARE SUPPLIED AND INSTALLED BY SIEMENS.

THE CONCRETE FLOOR MUST BE LEVEL WITHIN 3/8" MAXIMUM DEVIATION IN THE AREA AROUND THE BASE OF THE GANTRY AND THE BASE OF THE PATIENT TABLE.



- ① (4) 11/16" HOLES THROUGH THE ADJUSTABLE FEET TO MOUNT THE GANTRY TO THE FLOOR IF REQUIRED, EX. EARTHQUAKE ZONES.
- ② (4) 1" HOLES THROUGH FLOOR PLATE TO MOUNT THE PATIENT TABLE TO THE FLOOR.
- ③ (4) 1" ALTERNATE MOUNTING HOLES.
- ④ THIS FOOT MUST TOUCH THE FLOOR WHEN GANTRY IS TILTABLE.

MAXIMUM POSSIBLE EXTRACTION FORCE AT THESE POINTS IS 3776 POUNDS. (INCLUDES SAFETY-FACTOR 4).

1 GANTRY AND PATIENT TABLE MOUNTING DETAIL

SCALE: 1/2"=1'-0"

FLOOR SURFACE REQUIREMENTS

THE GANTRY AND PATIENT TABLE MUST BE INSTALLED ON THE SAME PLANE. IT IS THE CUSTOMER'S RESPONSIBILITY TO MEET FLOOR LEVELNESS SPECIFICATIONS AS OUTLINED IN THIS DETAIL. THE GANTRY AND PATIENT TABLE MUST BE PLACED DIRECTLY ON THE CONCRETE FLOOR. EXISTING FLOOR COVERING IN THE AREA OF THE INSTALLATION SURFACE AND ATTACHMENT POINTS OF THE GANTRY AND THE ENTIRE FOOTPRINT AREA OF THE PATIENT TABLE BASE MUST BE REMOVED AND REPLACED WITH SHIMS OF THE APPROPRIATE THICKNESS. ANTI-STATIC FLOORING IS RECOMMENDED IN THE EXAMINATION ROOM. THE GANTRY AND PATIENT TABLE RESTS ON ADJUSTABLE FEET AND ANY LEVELING IS DONE WITH THE ADJUSTABLE FEET.

BOLTING REQUIREMENTS

THE WEIGHT CAPACITY OF THE FLOOR MUST BE EVALUATED BY A STRUCTURAL ENGINEER. BOLTING THE GANTRY TO THE FLOOR IS ONLY NECESSARY WHEN LOCAL OR NATIONAL REGULATIONS REQUIRE IT (EXAMPLE: EARTHQUAKE ZONES). BOLT THE GANTRY TO THE FLOOR USING ANCHORS THROUGH THE ADJUSTABLE FEET. MATERIALS FOR BOLTING MUST BE SUPPLIED ON-SITE. THE PATIENT TABLE MUST ALWAYS BE BOLTED TO THE FLOOR THROUGH THE ATTACHMENT POINTS IN THE TABLE PEDESTAL. A DRILLING TEMPLATE AND ALL INSTALLATION MATERIALS ARE INCLUDED IN THE DELIVERY FOR STANDARD ANCHORING. MIN. CONCRETE THICKNESS 5 1/2". DRILL AND TOOLS TO BE AVAILABLE ON-SITE. THE MINIMUM EXTRACTION FORCE OF 944 POUNDS PER ATTACHMENT POINT IS REQUIRED.

THE FOLLOWING APPROVED CHEMICAL ANCHORS MAY BE USED WHEN STANDARD ANCHORS ARE NOT POSSIBLE. TO BE SUPPLIED BY THE CUSTOMER/CONTRACTOR:
 1. HILTI INJECTABLE ADHESIVE ANCHOR: HIT-RE 500-V3 HARDENING TIME AT TEMP. FROM 68°-75° = 7 HOURS
 2. HILTI INJECTABLE ADHESIVE ANCHOR: HIT-HY 200-A HARDENING TIME AT TEMP. FROM 70°-86° = 30 MIN.
 3. HILTI INTERNALLY THREADED INSERT: HIS-N M10X110 USE THIS SIZE WHEN REPLACING AN ANCHOR. MIN. CONCRETE THICKNESS: 6"
 4. HILTI INTERNALLY THREADED INSERT: HIS-N MBX90 USED WHEN MOUNTING HOLES HAVE NOT BEEN DRILLED. MIN. CONCRETE THICKNESS: 4 3/4".

IT IS THE RESPONSIBILITY OF THE STRUCTURAL ENGINEER TO DETERMINE THE ANCHORING DEPTH AND CONCRETE STRENGTH NEEDED TO INSTALL THE TABLE BASE WITH THE SIEMENS SUPPLIED ANCHORS OR EQUIVALENT ANCHORS SPECIFIED BY THE STRUCTURAL ENGINEER AND SUPPLIED BY THE CUSTOMER/ CONTRACTOR.

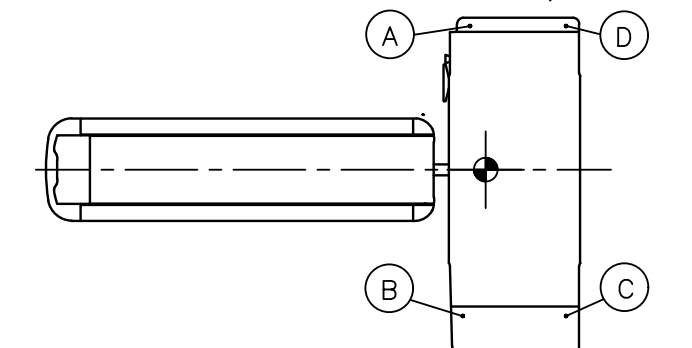
STRUCTURAL NOTES

- 1) THE CUSTOMER/CONTRACTOR SHALL FURNISH AND INSTALL ALL STRUCTURAL SUPPORT MEMBERS AND NEEDED HARDWARE FOR THE INSTALLATION OF THE SIEMENS EQUIPMENT.
- 2) THE OVERHEAD STRUCTURAL SUPPORT SYSTEM SHALL BE FIXED, RIGID AND BRACED FOR SWAY.
- 3) ALL STRUCTURAL SUPPORT MEMBERS SHALL BE TRUE, SQUARE, LEVEL, PARALLEL AND COPLANAR WITH RESPECT TO EACH OTHER, WITH A HORIZONTAL STRUCTURAL SUPPORT MEMBER TO BE LOCATED AND SET WITH A TRANSIT.
- 4) ALL STRUCTURAL SUPPORT DETAILS SHOWN ARE SAMPLE DETAILS BASED UPON TYPICAL AND STANDARD BUILDING PRACTICES AND ARE NOT INTENDED AS ACTUAL CONSTRUCTION DETAILS. ALL CONSTRUCTION DETAILS AND SUPPORT CALCULATIONS SHALL BE PREPARED BY A PROFESSIONAL STRUCTURAL ENGINEER AT THE CUSTOMER'S EXPENSE. IN THE EVENT AN EXISTING SUPPORT SYSTEM IS TO BE USED, IT WILL BE THE CUSTOMER'S RESPONSIBILITY TO VERIFY THE INTEGRITY OF THAT SYSTEM.
- 5) MOUNTING PLATES, FRAMES, AND HARDWARE SUPPLIED BY SIEMENS AS DETAILED IN THIS DRAWING SET ARE INSTALLED BY SIEMENS UNLESS OTHERWISE REQUIRED. ANY DEVIATION FROM THE PROVIDED MATERIALS OR MOUNTING METHODS MUST BE DESIGNED AND DOCUMENTED BY THE STRUCTURAL ENGINEER OF RECORD. ALTERNATE MOUNTING MATERIALS (I.E. ANCHORS, THREADED ROD, BACKING PLATES, ETC.) MUST BE SUPPLIED BY THE CUSTOMER/CONTRACTOR. SIEMENS MAY REQUIRE ASSISTANCE FROM THE CUSTOMER/CONTRACTOR WITH INSTALLATION WHEN UTILIZING ALTERNATE MOUNTING MATERIALS.
- 6) ALL CEILING FIXTURES (I.E. AIR SUPPLY GRILLES, AIR RETURN GRILLES, EXHAUST GRILLES, SPRINKLER HEADS, INCANDESCENT AND FLUORESCENT LIGHT FIXTURES, INTERCOM SPEAKERS, MEDICAL GAS COLUMNS, ETC.) SHALL BE INSTALLED FLUSH MOUNTED WITH THE FINISHED CEILING TO PROVIDE FREE AND UNRESTRICTED TRAVEL OF THE SMS CEILING MOUNTED EQUIPMENT.
- 7) THE BOTTOM SIDE OF THE UNISTRUT CEILING GRID AND ANY CEILING MOUNTED SUPPORT PLATES ARE TO BE INSTALLED FLUSH WITH THE FINISHED CEILING. THE CUSTOMER/CONTRACTOR SHALL ALSO PROVIDE COVERSTRIPS FOR THE UNISTRUT.
- 8) THE STRUCTURAL PLANNING AS SHOWN ON THE 1/4" STRUCTURAL PLAN HAS BEEN COORDINATED WITH THE EQUIPMENT LOCATION AS SHOWN ON THE 1/4" EQUIPMENT LAYOUT PLAN. FOR THIS REASON, ANY DEVIATIONS FROM THE STRUCTURAL PLANNING AS SHOWN MUST BE APPROVED BY SMS PLANNING DEPARTMENT.
- 9) THE STRUCTURAL ENGINEER OF RECORD SHALL BE RESPONSIBLE FOR THE DESIGN AND DETAIL OF FLOOR, WALL, AND CEILING STRUCTURES IN ACCORDANCE WITH THE STRUCTURAL INFORMATION SHOWN, AND LOCAL GOVERNING BUILDING CODES.
- 10) ALL ANCHORS, SUPPORTS AND BRACES FOR SECURING THE SIEMENS EQUIPMENT ON THE UNDERSIDE OF THE CONCRETE SLAB (WHETHER SUPPLIED BY SIEMENS OR CONTRACTOR) SHALL BE SECURED IN A MANNER TO PREVENT THEM FROM FALLING DURING A DE-INSTALLATION. ALL WORK FOR SECURING THESE MOUNTS SHALL BE BY THE CONTRACTOR.

FLOOR LOADING

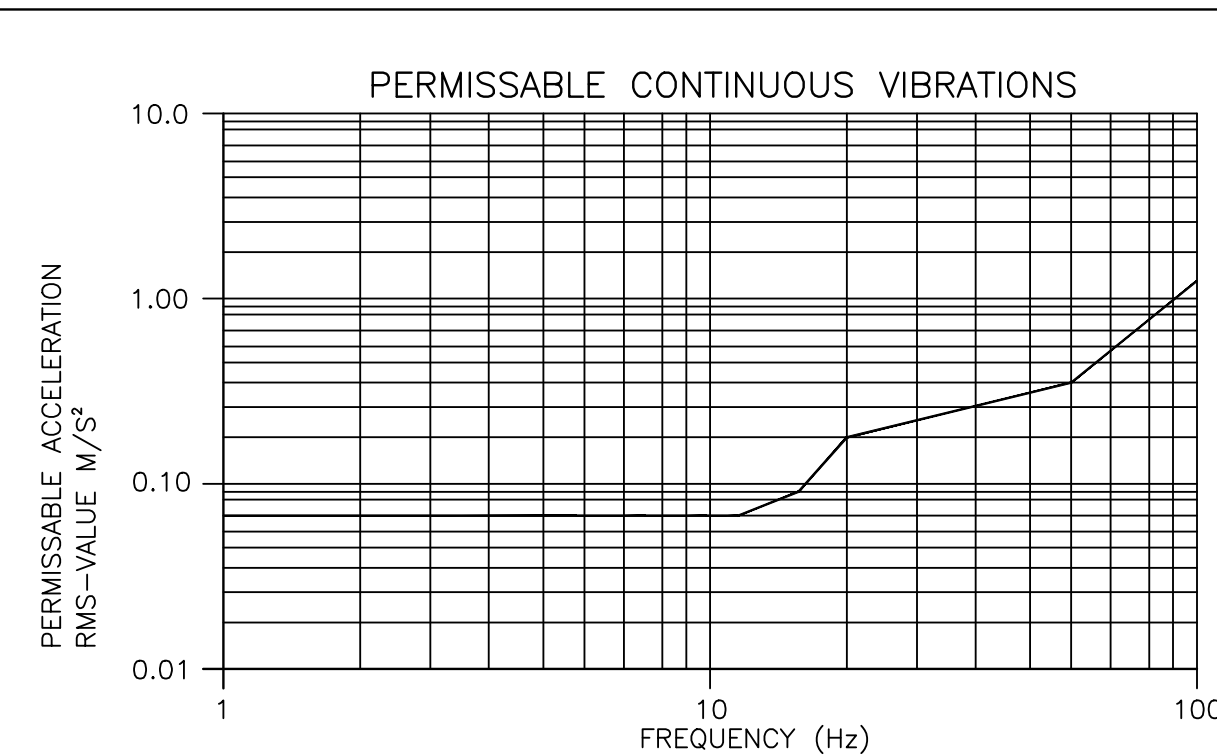
DESCRIPTION				
F STAT MAX	STATIC FLOOR LOAD DUE TO GANTRY'S OWN WEIGHT			
AMPLITUDE F DYN	DIFFERENCE BETWEEN MINIMUM AND MAXIMUM FLOOR LOADING DURING GANTRY ROTATION			
TABLE OF PARAMETERS				
GANTRY MEASUREMENT POINTS	F STAT MAX (POUNDS)	AMPLITUDE FOR F DYN (POUNDS)	SUPPORT SURFACE	DIAMETER
(A)	771	+/- 67	2 1/2 IN ²	2 1/8 IN
(B)	1036	+/- 67		
(C)	1182	+/- 67		
(D)	850	+/- 67		

THE FLOOR STRUCTURE MUST WITHSTAND THE OCCUPIED WEIGHT OF THE GANTRY AND THE INDIVIDUAL CONTACT LOADING AREA. DURING GANTRY INSTALLATION AND LEVELING, THE MAXIMUM POSSIBLE LOAD ON ONE GANTRY FOOT IS 2219 POUNDS (WITH THE GANTRY STANDING ON TWO DIAGONAL FEET).



TOTAL STATIC LOAD, RESULTING IN THE CENTER OF GRAVITY OF THE GANTRY: 3840 POUNDS.

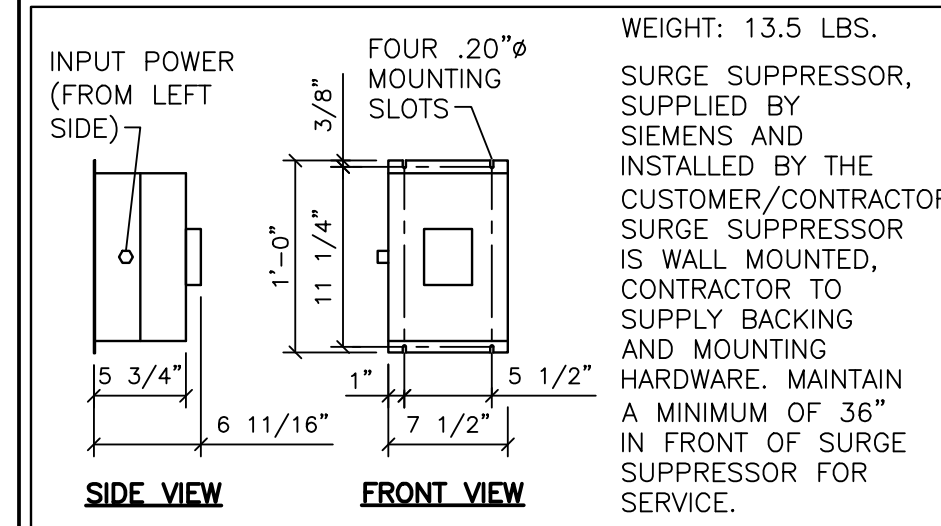
FLOOR AND BUILDING VIBRATIONS



TRANSIENT VIBRATIONS (SHOCKS)
 ANY TRANSIENT VIBRATION HAS TO BE LESS THAN 0.5 M/S² PEAK-TO-PEAK IN THE TIME DOMAIN. THE VIBRATIONS HAVE TO BE MEASURED WITH A SAMPLING RATE OF 1000Hz.

THE CT SYSTEM IS NOT SENSITIVE TO COMMON VIBRATIONS, IF THE CT IS AWAY FROM VIBRATIONAL SOURCES OR THE CT IS REPLACING A CT SYSTEM, THAT TO DATE, HAS NOT SHOWN IMAGE QUALITY PROBLEMS DUE TO VIBRATIONS. IT IS USUALLY NOT NECESSARY TO EXECUTE VIBRATIONAL MEASUREMENTS. IF THERE ARE ANY DOUBTS, THE FOLLOWING THRESHOLDS HAVE TO BE VERIFIED BY MEASUREMENT: IN THE THREE SPATIAL DIRECTIONS, ACCELERATION IN VIBRATIONS AT THE MOUNTING POINTS OF THE GANTRY AND THE PATIENT TABLE MUST NOT EXCEED THE THRESHOLDS AS DESCRIBED HERE.

THE THRESHOLD IS DEFINED AS ACCELERATION RMS VALUE (ROOT MEAN SQUARE) IN M/S² OF AN FFT SPECTRUM DERIVED WITH A FREQUENCY RESOLUTION OF 1 Hz AND USING A HANNING-WINDOW. THE VIBRATIONS HAVE TO BE MEASURED WITH A SAMPLING RATE OF 1000Hz USING AN ANTI-ALIASING-FILTER WITH A LIMIT FREQUENCY OF 250Hz. THE THRESHOLD IS VALID FOR VIBRATIONS AT THE INSTALLATION LOCATION WITH A CT IN POSITION. MEASUREMENTS MUST BE TAKEN PRIOR TO THE INSTALLATION OF THE CT, THEREFORE CHANGES IN THE EIGENFREQUENCY OF THE SLAB CAUSED BY THE ADDITIONAL MASS OF THE CT MUST BE CONSIDERED WHEN COMPARING THE FREQUENCY SPECTRUM WITH THE THRESHOLD.



PARALLEL SURGE SUPPRESSOR UNIT MUST BE LOCATED WITHIN 3 FEET CABLE RUN FROM CIRCUIT BREAKER.

2 SURGE SUPPRESSOR

SCALE: NONE

FINISHED ROOM HEIGHT	
FOR CT GANTRY ONLY	MINIMUM 7'-2 5/8"
FOR CT GANTRY WITH GANTRY ARM	MINIMUM 7'-10 1/2"
CAREVISION MONITOR/CEILING MOUNT	SEE DETAIL ON S-102 SHEET

SYM	DATE	DESCRIPTION
08/28/23	2202476R	DATED 08/28/23 APPROVED BY CUSTOMER FOR FINALS

PROJECT MANAGER: JASON BOSWELL
 TEL: (919) 368-5780
 FAX: (800) 727-7156 EXT:
 EMAIL: JASON.BOSWELL@SIEMENS-HEALTHINEERS.COM

SIEMENS
CENTRAL HARNETT HOSPITAL
 215 BRIGHTWATER DR, LILLINGTON, NC 27546
 FLOOR: GROUND/ ROOMNO: CT SIM - SOMATOM GO.OPEN PRO

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ALL RIGHTS ARE RESERVED.

PROJECT #: **2202476** SHEET: **S-101**
 SHEET 3 OF 7 DRAWN BY: J. DRAMIS
 DATE: 08/28/23

SCALE: AS NOTED REF. #: 30267651

ATTENTION:

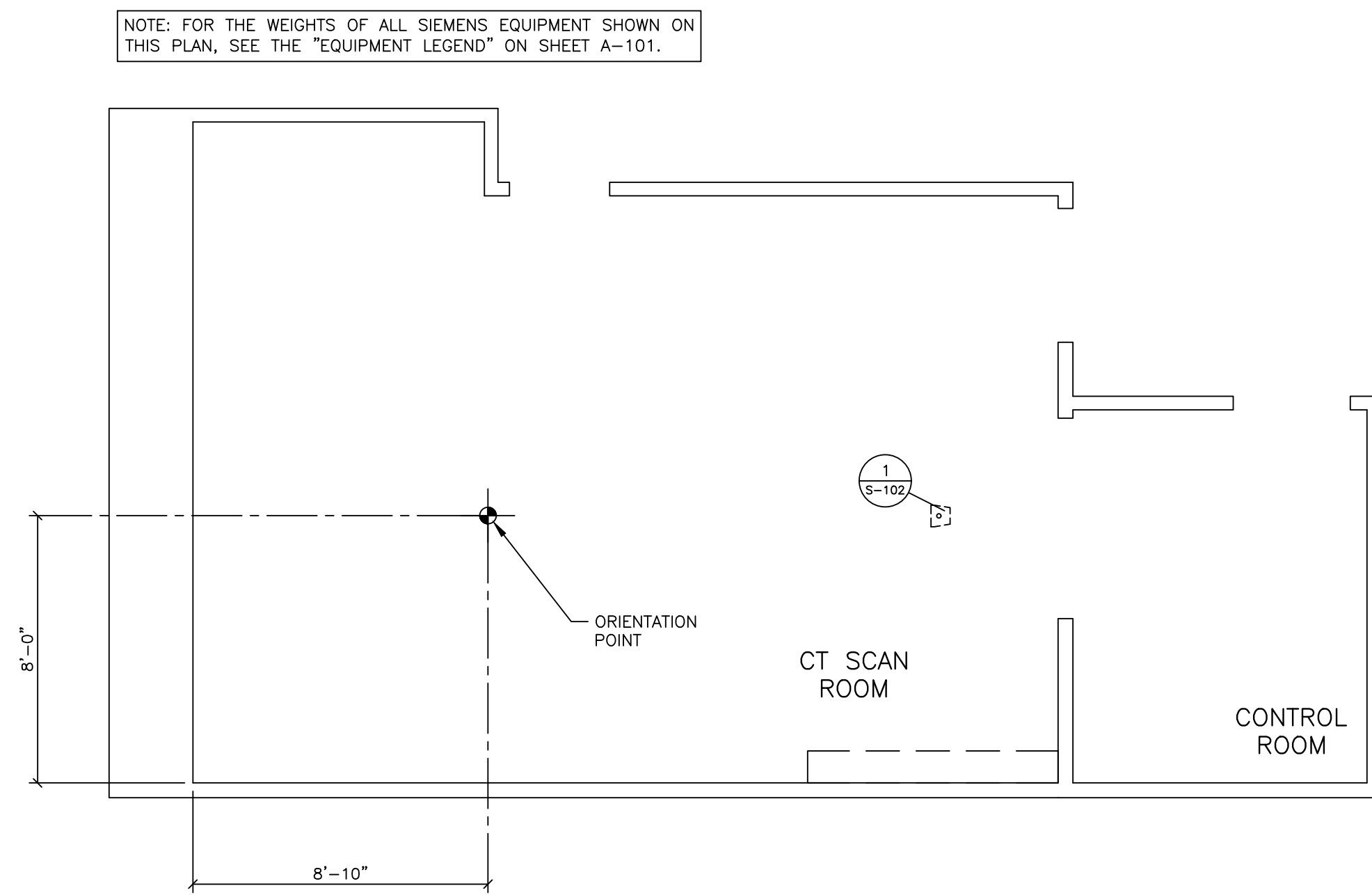
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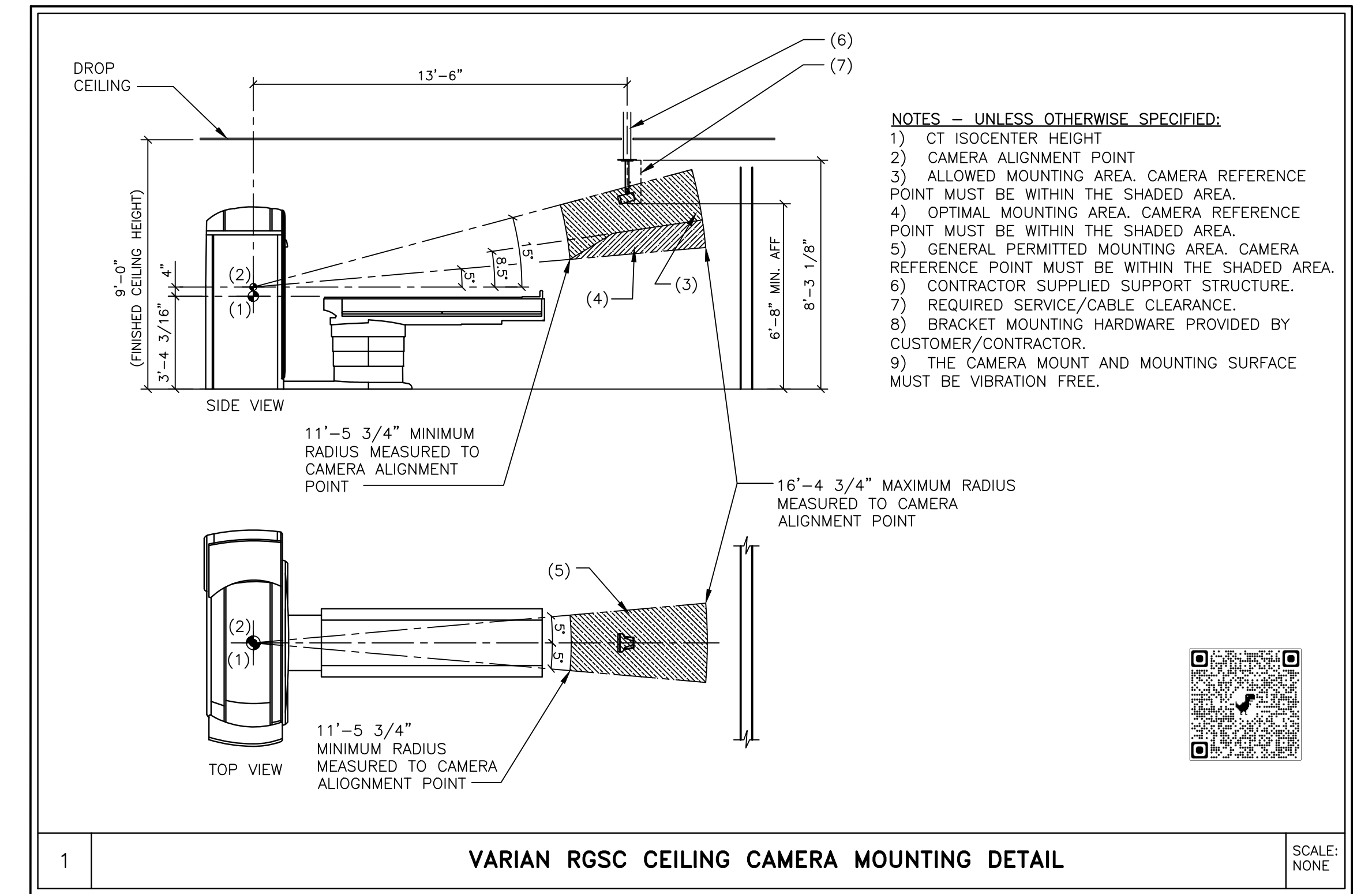
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GO-SIM REV 14



STRUCTURAL CEILING PLAN

SCALE: 1/4" = 1'-0"



FINISHED ROOM HEIGHT	
FOR CT GANTRY ONLY	MINIMUM 7'-2 5/8"
FOR CT GANTRY WITH GANTRY ARM	MINIMUM 7'-10 1/2"
CAREVISION MONITOR/CEILING MOUNT	SEE DETAIL ON S-102 SHEET

PROJECT MANAGER: JASON BOSWELL TEL: (919) 368-5780 FAX: (800) 727-7156 EXT: EMAIL: JASON.BOSWELL@SIEMENS-HEALTHINEERS.COM		SIEMENS	
CENTRAL HARNETT HOSPITAL 215 BRIGHTWATER DR, LILLINGTON, NC 27546 FLOOR: GROUND/ ROOMNO: CT SIM - SOMATOM GO.OPEN PRO			
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ALL RIGHTS ARE RESERVED.		SHEET 4 OF 7 DRAWN BY: J. DRAMIS	
SCALE: AS NOTED	REF. #: 30267651	DATE: 08/28/23	

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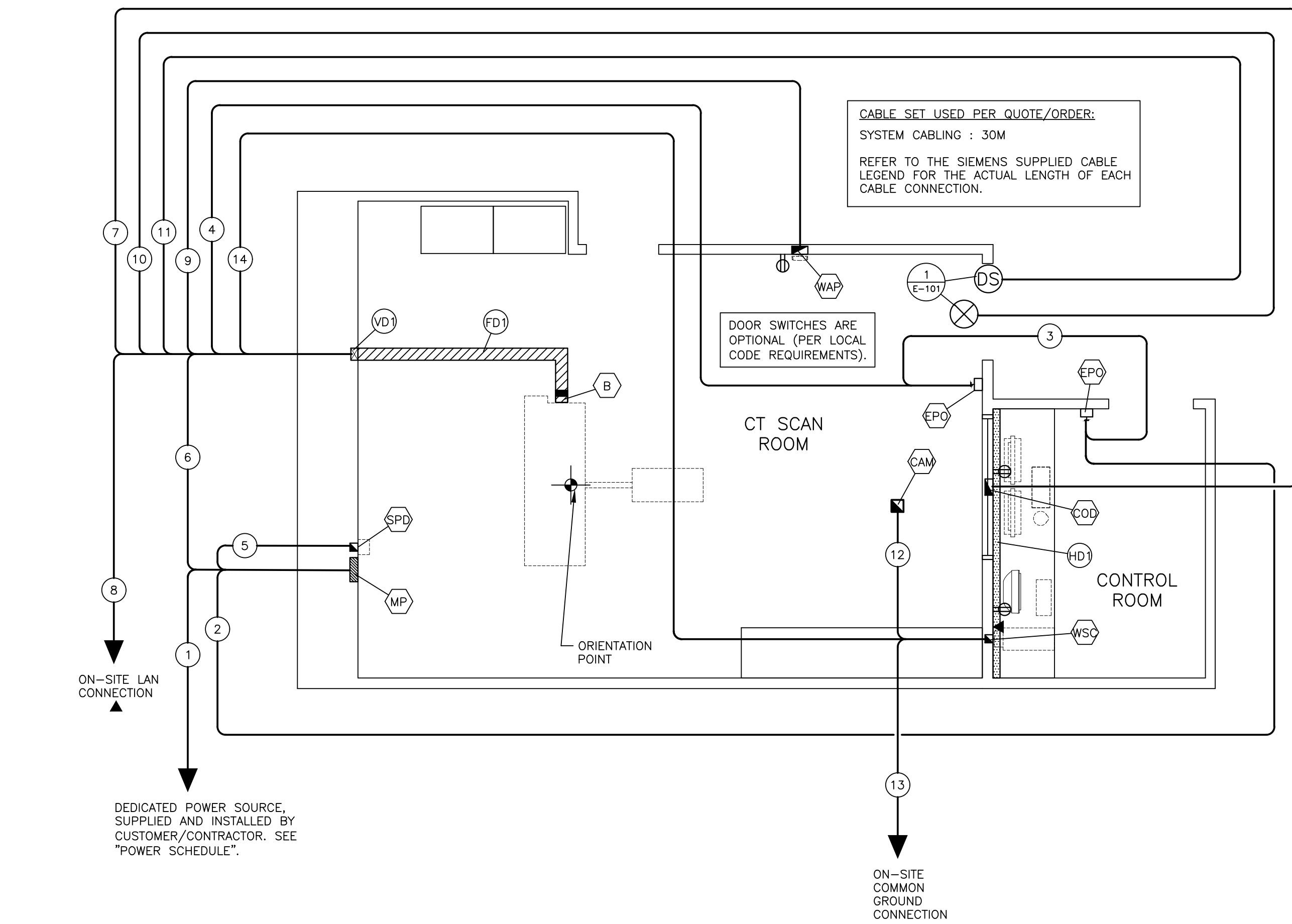
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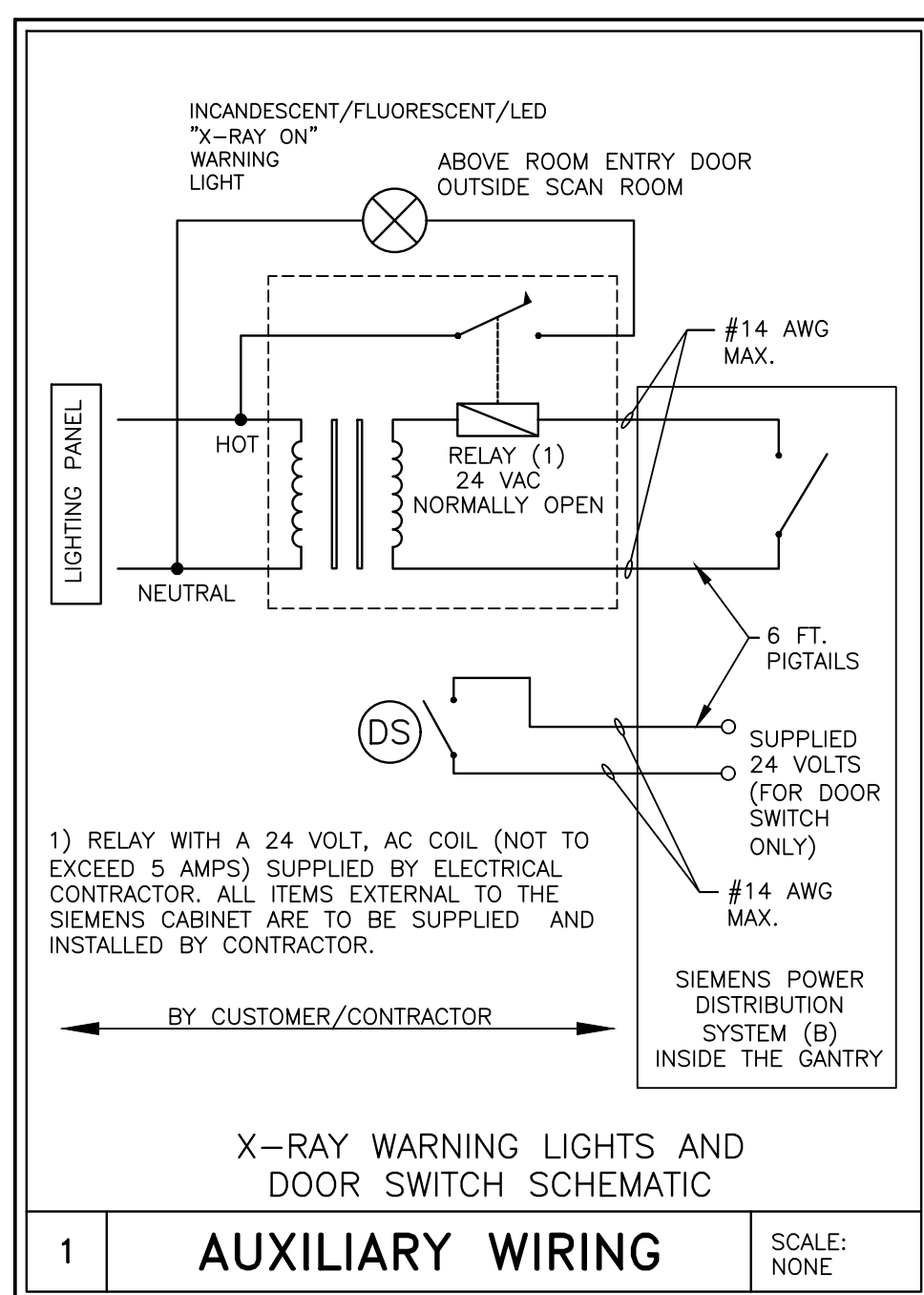
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 -ISSUE BLOCK-

REFERENCE DOCUMENT - NOT FOR CONSTRUCTION

60-SIM
REV 14



ELECTRICAL RACEWAY PLAN



POWER REQUIREMENTS				
SYSTEM	SUPPLY VOLTAGE (VOLTS)	POWER CONSUMPTION (kVA)	SUPPLY IMPEDANCE (mΩ)	MAIN CIRCUIT BREAKER (AMPS)
GANTRY WITH PATIENT TABLE	3φ 480/277V ±10%	SEE BELOW	≤ 300	125

POWER CONSUMPTION OF GANTRY WITH PATIENT TABLE
 OPERATING FOR 4 SEC. ≤ 115 kVA
 OPERATING FOR 10 SEC. ≤ 100 kVA
 OPERATING FOR 30 SEC. ≤ 75 kVA
 OPERATING FOR 50 SEC. ≤ 63 kVA
 OPERATING FOR 100 SEC. ≤ 40 kVA
 STAND-BY ≤ 3 kVA

IF AN ON-SITE TRANSFORMER IS REQUIRED TO OBTAIN CT OPERATING VOLTAGE, IT MUST BE OF SUFFICIENT CAPACITY AND CHARACTERISTICS TO MAINTAIN SUPPLY VOLTAGE AND IMPEDENCE REQUIREMENTS (TRANSFORMER AND CONDUCTORS).

DO NOT CONNECT ANY EXTERNAL USERS TO THE CT POWER LINES.

THE EXAMINATION ROOM SHOULD BE EQUIPPED WITH AT LEAST ONE EMERGENCY POWER OFF (PANIC) BUTTON.

CONDUIT LENGTH CALCULATIONS	
IF SITE SPECIFIC CONDITIONS EXCEED THE FOLLOWING ASSUMED VALUES THEN ADDITIONAL LENGTH MUST BE SUBTRACTED BY THE ELECTRICAL CONTRACTOR FROM THE MAXIMUM CONDUIT LENGTHS LISTED.	
IF DUCT LOCATIONS ARE ALTERED FROM THE SHOWN LAYOUT IT IS THE ELECTRICAL CONTRACTOR'S RESPONSIBILITY TO RECALCULATE THE MAXIMUM CONDUIT LENGTHS.	
ASSUMED VALUES USED IN CALCULATING STATED MAXIMUM CONDUIT LENGTHS:	
VERTICAL DUCTS = 10'-0"	
FLOOR PENETRATIONS = 3'-0"	

SYMBOLS	
ALL MAY NOT APPLY	
	MAIN PANEL OR ENCLOSURE BY CUSTOMER/CONTRACTOR
	OPENING IN RACEWAY OR TRENCH/DUCT
	PULLBOX IN (FLOOR/WALL/CEILING)
	OPENING IN ACCESS FLOORING
	WARNING LIGHT (X-RAY ON)
	DOOR SAFETY SWITCH
	(EPO) EMERGENCY POWER OFF BUTTON
	TRENCH/DUCT
	CEILING DUCT
	UNDER FLOOR DUCT
	SURFACE DUCT
	VERTICAL DUCT
	ETHERNET CONNECTION TO CUSTOMER'S INFORMATION SYSTEMS NETWORK (VERIFY WITH SMS PROJECT MANAGER).
	110 VOLT, 20 AMP, HOSPITAL GRADE DUPLEX OUTLET UNLESS OTHERWISE STATED.
	110 VOLT, 20 AMP, HOSPITAL GRADE QUAD OUTLET
	SPECIAL PURPOSE RECEPTACLE

POWER QUALITY	
POOR POWER WILL ALTER EQUIPMENT PERFORMANCE	
IT IS IN THE CUSTOMER'S INTEREST THAT THE ELECTRICAL CONTRACTOR BE RESPONSIBLE FOR TESTING AND VERIFYING THAT THE EQUIPMENT POWER SUPPLY COMPLIES WITH THE SIEMENS SPECIFICATIONS.	

ELECTRICAL LEGEND			
SYM	SIZE	DESCRIPTION	REMARKS
⑤	6" x 6"	OPENING IN TOP OF FLUSH MOUNTED RACEWAY IN SHOWN LOCATION.	GANTRY CABLE ACCESS
②	AS REQUIRED	PULL BOX MOUNTED ABOVE FINISHED CEILING IN SHOWN LOCATION.	CEILING MTD. RGSC CAMERA
②	AS REQUIRED	PULL BOX MOUNTED FLUSH WITH FINISHED WALL AT THE FLOOR LINE IN CONTROL AREA IN SHOWN LOCATION PROVIDED WITH 3" OPENING IN FINISHED COVER.	
②	---	EMERGENCY POWER OFF BUTTON. EXACT LOCATIONS TO BE DETERMINED BY CUSTOMER/CONTRACTOR.	SEE POWER SCHEDULE
②	---	MAIN PANEL WITH MAIN BREAKER. EXACT LOCATION DETERMINED BY CUSTOMER/CONTRACTOR.	SEE POWER SCHEDULE.
②	AS REQUIRED	PULL BOX MOUNTED FLUSH WITH FINISHED WALL PROVIDED WITH 2" OPENING IN FINISHED COVER. THE SURGE PROTECTIVE DEVICE MUST BE LOCATED WITHIN 3 FEET CABLE RUN FROM CIRCUIT BREAKER, AT HEIGHT DETERMINED BY CUSTOMER/CONTRACTOR.	SEE DETAIL S-101
②	8" x 8" x 4"	PULLBOX MOUNTED FLUSH WITH FINISHED WALL AT WIRELESS ACCESS POINT LOCATION AND 110 VOLT DUPLEX OUTLET. HEIGHT OFF FF: > 6'-6 3/4"	WIRELESS ACCESS POINT
②	AS REQUIRED	PULL BOX MOUNTED FLUSH WITH FINISHED WALL AT FLOORLINE IN CONTROL AREA.	RGSC WORKSTATION CABINET
②	6" x 3-1/2"	ELECTRICAL DUCT MOUNTED FLUSH WITH FINISHED FLOOR (TRENCH DUCT) AND PARALLEL WITH THE FLOOR SLAB IN SHOWN LOCATION. PROVIDED WITH WATERPROOF, REMOVABLE COVERS FINISHED TO MATCH FLOORING. DUCT TO BE DIVIDED INTO TWO SECTIONS WITH METAL DIVIDERS.	RACEWAY
②	6" x 3-1/2"	ELECTRICAL DUCT RUN HORIZONTALLY ON THE WALL AT THE FLOOR LINE AND SURFACE MOUNTED ON FINISHED WALL AS SHOWN FOR EXCESS CABLE STORAGE.	RACEWAY
②	6" x 3-1/2"	ELECTRICAL DUCT MOUNTED FLUSH WITH FINISHED WALL IN SHOWN LOCATION PROVIDED WITH FINISHED, REMOVABLE COVERS. TO EXTEND FROM FLOOR LINE TO END ABOVE FINISHED CEILING. DUCT TO BE DIVIDED INTO TWO SECTIONS WITH METAL DIVIDERS.	RACEWAY
①	AS REQUIRED	CONDUIT FROM "MP" TO "EPO" SIZED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
②	AS REQUIRED	CONDUIT FROM "MP" TO "EPO" SIZED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
③	AS REQUIRED	CONDUIT FROM "EPO" TO "EPO" SIZED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
④	AS REQUIRED	CONDUIT FROM "EPO" TO "VD1" (B) SIZED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
⑤	AS REQUIRED	CONDUIT FROM "MP" TO "SPD" SIZED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
⑥	AS REQUIRED	CONDUIT FROM "MP" TO "VD1" (B).	SEE POWER SCHEDULE
⑦	3"	CONDUIT FROM "VD1" (B) TO "COD".	MAX. CONDUIT LENGTH 68'-0"
⑧	1"	CONDUIT (IF NEEDED) FROM "VD1" (B) TO ON-SITE LAN	MAX. CONDUIT LENGTH 68'-0"
⑨	1"	CONDUIT FROM "VD1" (B) TO "WAP".	MAX. CONDUIT LENGTH 52'-0"
⑩	AS REQUIRED	CONDUIT FROM "VD1" (B) TO "WARNING LIGHT", SIZED BY ELECTRICAL ENGINEER OF RECORD.	
⑪	AS REQUIRED	CONDUIT FROM "VD1" (B) TO "DS", SIZED BY ELECTRICAL ENGINEER OF RECORD.	
⑫	2"	CONDUIT FROM "WSC" TO "CAM".	MAX. CONDUIT LENGTH 114'-0"
⑬	1"	CONDUIT FROM "WSC" TO "ON-SITE COMMON GROUND CONNECTION".	
⑭	1"	CONDUIT FROM "WSC" TO "VD1" (B).	MAX. CONDUIT LENGTH 52'-0"

CONTRACTOR SUPPLIED CABLES				
FROM	VIA	TO	DESCRIPTION	REMARKS
POWER SOURCE	1	MP	3-PHASE CONDUCTORS, 1 NEUTRAL, 1 GROUND. SIZED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
MP	2	EPO	DETERMINED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
EPO	3	EPO	DETERMINED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
EPO	4,VD1,FD1	B	DETERMINED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
MP	5	SPD	3-PHASE CONDUCTORS, 1 NEUTRAL AND 1 GROUND. SIZED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
MP	6,VD1,FD1	B	3 PHASE CONDUCTORS, 1 NEUTRAL AND 1 GROUND. SIZED BY ELECTRICAL ENGINEER OF RECORD.	SEE POWER SCHEDULE
B	FD1,VD1,10	WARNING LIGHT	DETERMINED BY ELECTRICAL ENGINEER OF RECORD.	
B	FD1,VD1,11	DS	DETERMINED BY ELECTRICAL ENGINEER OF RECORD.	
WSC	13	ON-SITE COMMON GROUND CONNECTION	MIN. BAWG WITH 8MM LUG; CONNECTED TO CT FACILITY GROUND	SEE MANUFACTURER'S REQUIREMENTS

SIEMENS SUPPLIED CABLES				
FROM	VIA	TO	DESCRIPTION	REMARKS
B	FD1,VD1,7	COD	POWER CABLE; W46:300V, DATA CABLE; W48:0V, W050:0V, W51:30V, W60:30V	MAXIMUM LENGTH 88'-0"
B	FD1,VD1,8	ON-SITE LAN	ETHERNET CABLE	MAXIMUM LENGTH 88'-0"
B	FD1,VD1,9	WAP	ETHERNET CABLE	MAXIMUM LENGTH 72'-0"
WSC	12	CAM	CAMERA DATA, NETWORK	MAXIMUM LENGTH 114'-0"
WSC	14,VD1,FD1	B	DATA CABLE	MAXIMUM LENGTH 72'-0"

FINISHED ROOM HEIGHT	
FOR CT GANTRY ONLY	MINIMUM 7'-2 5/8"
FOR CT GANTRY WITH GANTRY ARM	MINIMUM 7'-10 1/2"
CAREVISION MONITOR/CEILING MOUNT	SEE DETAIL ON S-102 SHEET

SYM	DATE	DESCRIPTION
	08/28/23	2202476R DATED 08/28/23 APPROVED BY CUSTOMER FOR FINALS

PROJECT MANAGER: JASON BOSWELL
 TEL: (919) 368-5780
 FAX: (800) 727-7156 EXT:
 EMAIL: JASON.BOSWELL@SIEMENS-HEALTHINEERS.COM

CENTRAL HARNETT HOSPITAL
 215 BRIGHTWATER DR, LILLINGTON, NC 27546
 FLOOR: GROUND/ ROOMNO: CT SIM - SOMATOM GO.OPEN PRO

PROJECT #: **2202476** SHEET: **E-101**

DATE: 08/28/23 DRAWN BY: J. DRAMIS

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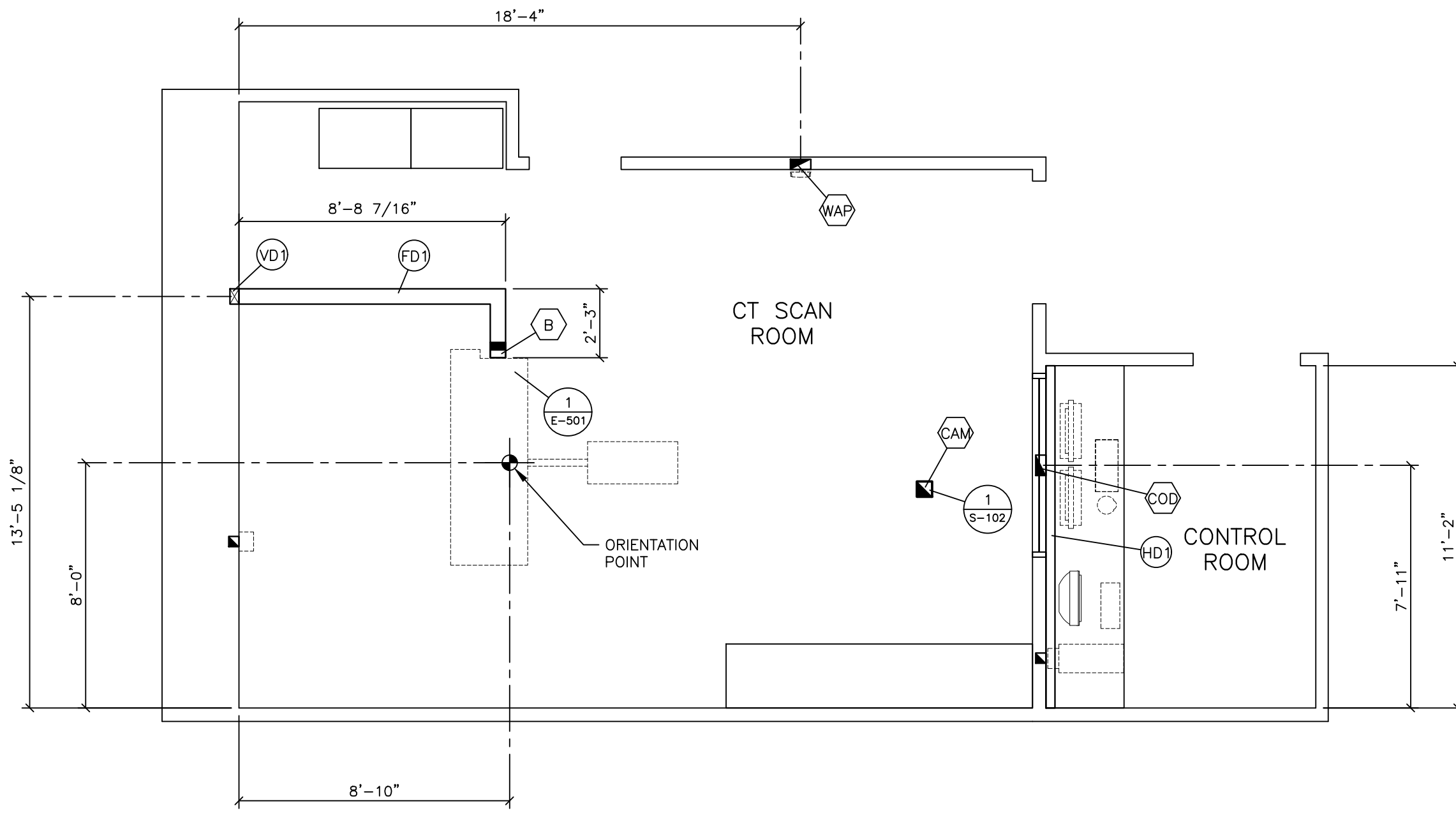
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 SCALE: AS NOTED REF. #: 30267651

DATE: 08/28/23

SIEMENS
CENTRAL HARNETT HOSPITAL
E-101



ELECTRICAL DIMENSION PLAN

SCALE: 1/4" = 1'-0"

FINISHED ROOM HEIGHT	
FOR CT GANTRY ONLY	MINIMUM 7'-2 5/8"
FOR CT GANTRY WITH GANTRY ARM	MINIMUM 7'-10 1/2"
CAREVISION MONITOR/CEILING MOUNT	SEE DETAIL ON S-102 SHEET

PROJECT MANAGER: JASON BOSWELL TEL: (919) 368-5780 VMAIL: (800) 727-7156 EXT: FAX: EMAIL: JASON.BOSWELL@SIEMENS-HEALTHINEERS.COM		SIEMENS	
CENTRAL HARNETT HOSPITAL			
215 BRIGHTWATER DR, LILLINGTON, NC 27546 FLOOR: GROUND/ ROOMNO: CT SIM - SOMATOM GO.OPEN PRO			
THE USE OR REPRODUCTION OF THIS TITLE BLOCK WITHOUT SIEMENS AUTHORIZATION WILL RESULT IN PROSECUTION UNDER FULL EXTENT OF THE LAW.		PROJECT #: 2202476	SHEET: E-102
ALL RIGHTS ARE RESERVED.		SHEET OF 6 OF 7	DRAWN BY: J. DRAMIS
SCALE: AS NOTED	REF. #: 30267651	DATE: 08/28/23	

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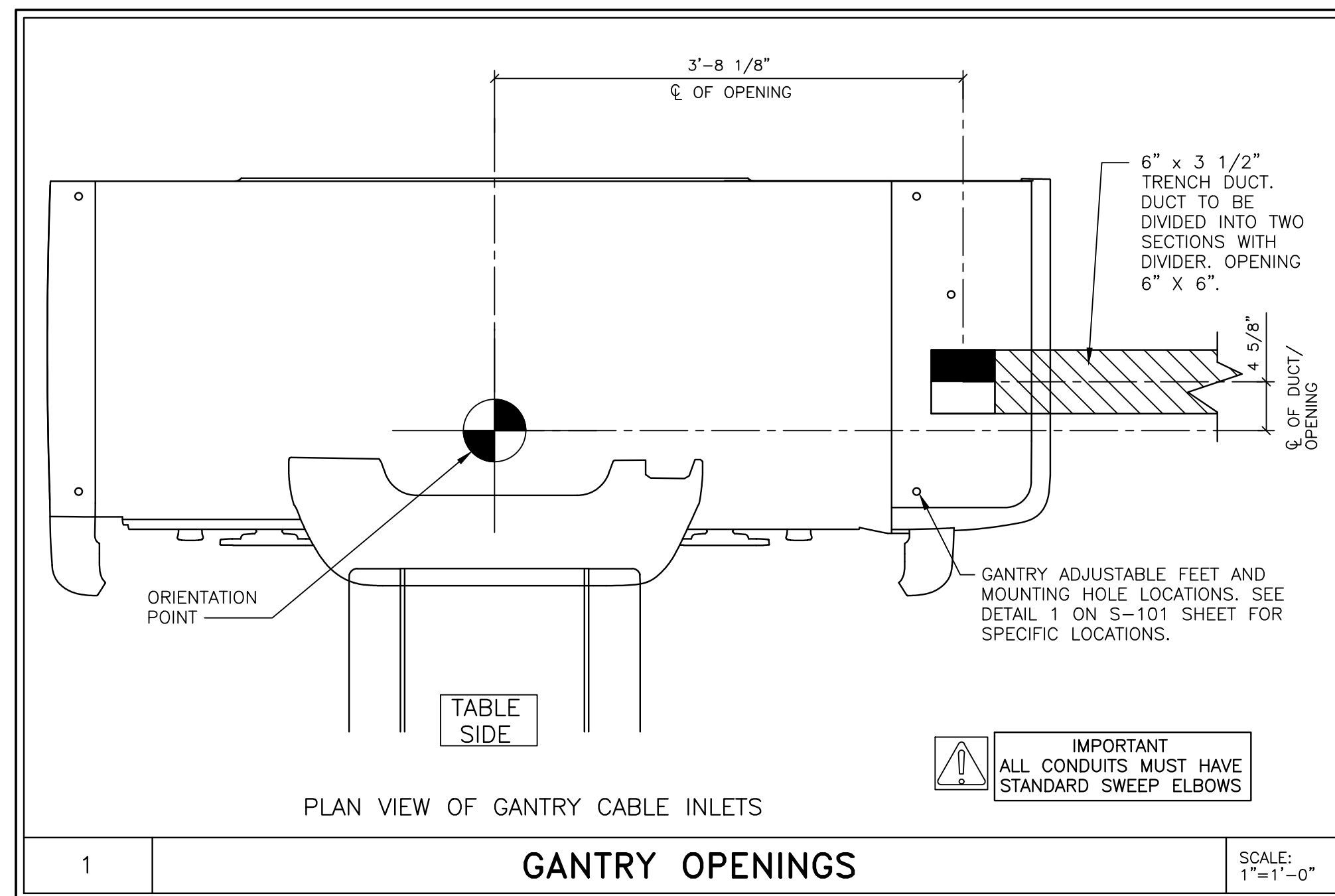
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GROUNDING NOTES

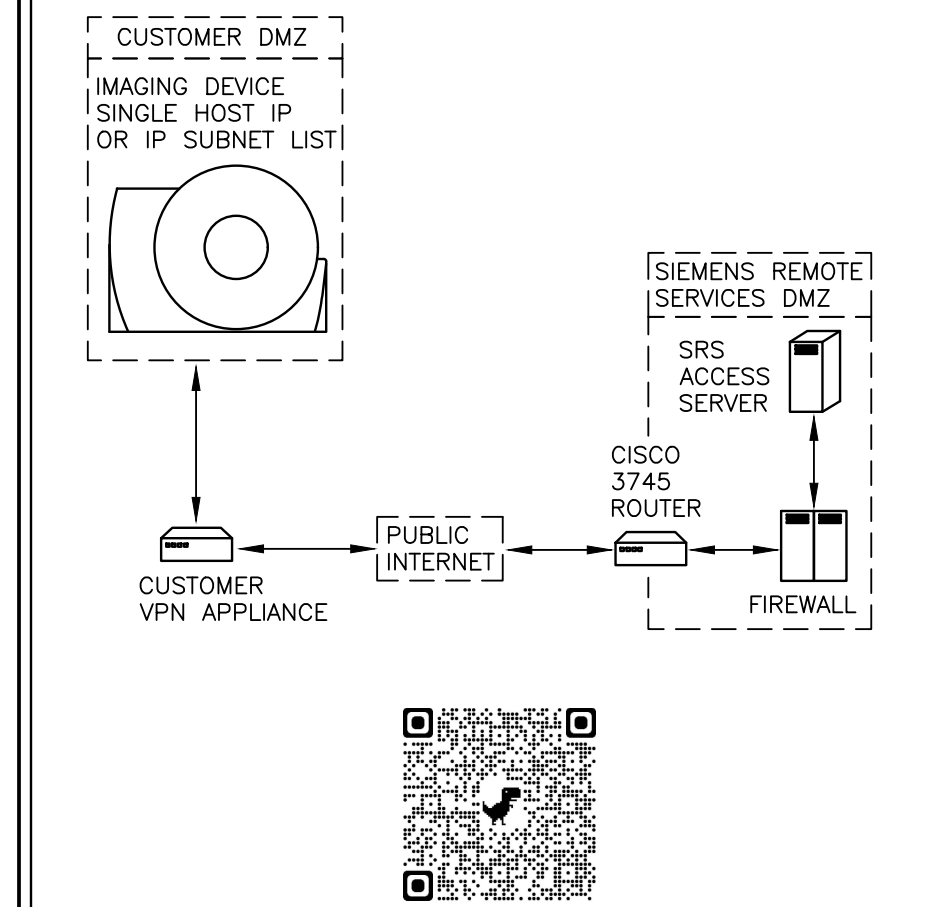
- EQUIPMENT GROUNDING CONDUCTOR TO COMPLY WITH THE FOLLOWING:
- 1) SIZE GROUNDING WIRE TO SIEMENS EQUIPMENT PER POWER SCHEDULE REQUIREMENTS.
 - 2) DERIVED FROM THE ELECTRICAL SERVICE, TRANSFORMER OR MAIN DISTRIBUTION PANEL FEEDING THE SIEMENS EQUIPMENT.
 - 3) RUN IN THE SAME CONDUIT, TROUGH OR RACEWAY AS THE PHASE CONDUCTORS.
 - 4) CONTINUOUS, WITH NO BREAKS OR USE OF CONDUIT, CHASSIS OR EARTH AS THE SOLE GROUNDING PATH.
 - 5) BONDED TO CHASSIS AND/OR CONDUIT IN ACCORDANCE WITH THE NEC REQUIREMENTS.
 - 6) MINIMIZE CONNECTIONS OR TERMINALS TO ENSURE CONTINUITY OVER THE LIFE OF THE INSTALLATION.
 - 7) AS A NORM, THERE SHOULD NOT BE ANY CURRENT PRESENCE ON THE GROUND CONDUCTOR, BUT IT IS ACCEPTABLE TO HAVE $\leq 500\text{mA}$ DURING OPERATION OF THE IMAGING EQUIPMENT.

SIEMENS SMART REMOTE SERVICE

TO ENSURE THE UPTIME OF YOUR SYSTEM DURING THE WARRANTY PERIOD (AND BEYOND WITH A SERVICE AGREEMENT), SIEMENS REMOTE SERVICES (SRS) REQUIRES REMOTE LOCAL AREA NETWORK ACCESS TO SIEMENS SYSTEMS.

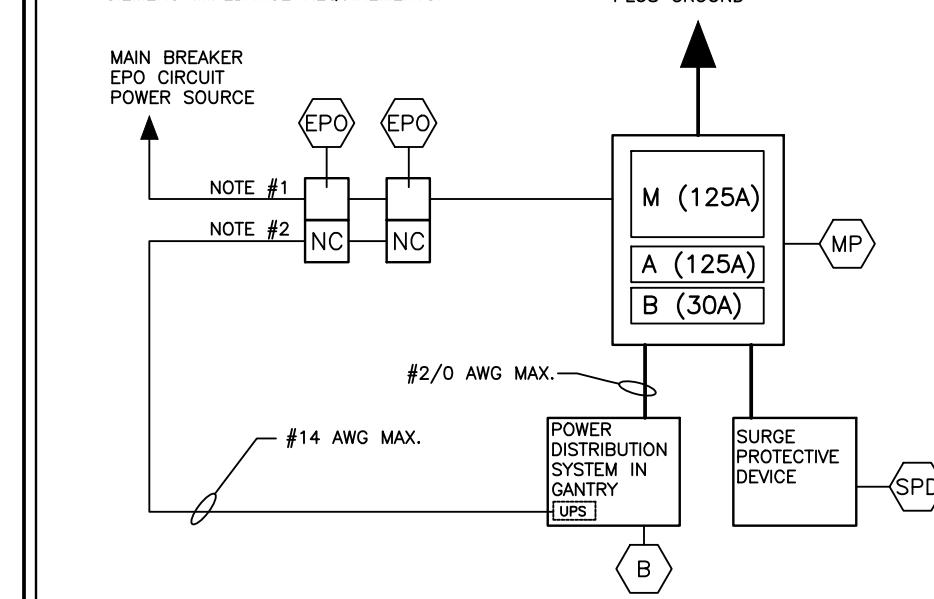
THE PREFERRED CONNECTION METHOD IS (VPN) VIRTUAL PRIVATE NETWORK (WHERE THE CUSTOMER HAS AVAILABLE A VPN CAPABLE FIREWALL OR OTHER VPN APPLIANCE). THIS METHOD PROVIDES THE POSSIBILITY FOR REMOTE SYSTEM DIAGNOSTICS WITHOUT ADDITIONAL HARDWARE. PLEASE CONTACT SIEMENS SMART REMOTE SERVICES TO DETERMINE BEST IMPLEMENTATION FOR YOUR SITE. CONTACT:

IMCPTSCSRS.DL@SIEMENS-HEALTHINEERS.COM.



POWER SCHEDULE

ALL CONDUITS AND WIRES SIZES MUST BE DETERMINED BY THE ELECTRICAL ENGINEER OF RECORD PER NEC AND TO MAINTAIN SIEMENS IMPEDANCE REQUIREMENTS.



ITEM	QTY	DESCRIPTION
MP	1	MAIN PANEL WITH CIRCUIT BREAKERS FLUSH OR SURFACE MOUNTED.
M	1	MAIN BREAKER MUST HAVE TRIPPING DEVICE SO WHEN ANY EPO IS PRESSED THE BREAKER TRIPS. MAIN BREAKER AMPS: 125
		VOLTS PHASES NEUTRAL GROUND TOTAL WIRES
		480/277Y 3 1 1 5
A	1	BREAKER AMPS: 125 (FOR GANTRY "A")
		VOLTS PHASES NEUTRAL GROUND TOTAL WIRES
		480/277Y 3 1 1 5
B	1	BREAKER AMPS: 30 (FOR SURGE PROTECTIVE DEVICE "SPD") (THIS BREAKER WILL NOT BE NEEDED IF THE SURGE PROTECTIVE DEVICE IS NOT PURCHASED)
		VOLTS PHASES NEUTRAL GROUND TOTAL WIRES
		480/277Y 3 1 1 5

PHASE AND NEUTRAL WIRES TO BE SAME SIZE. GROUND PER NEC.
UNLESS OTHERWISE NOTED, ALL BREAKERS WILL BE 80% RATED

EPO VARIES

NOTE 1 - EPO CIRCUIT #1
MAIN CIRCUIT BREAKER EMERGENCY POWER OFF BUTTON WITH PROTECTIVE COVER THAT PREVENTS ACCIDENTAL ACTIVATION. THE EPO MUST BE OF FAIL-SAFE DESIGN. ALL EPO'S TO HAVE MECHANICAL LATCHING MECHANISM. EPO MUST BE RESET BEFORE MAIN BREAKER CAN RESUME OPERATION. CONTACTS AND WIRING CONFIGURATION TO BE DESIGNED BY ELECTRICAL ENGINEER OF RECORD.

NOTE 2 - EPO CIRCUIT #2
EPO CONTACTS TO BE NORMALLY CLOSED, WIRED IN SERIES, CONNECTED TO CT (B) UPS ONLY.

THE EPOs MUST BE INSTALLED BY A QUALIFIED ELECTRICAL CONTRACTOR ACCORDING TO NATIONAL ELECTRICAL CODE, STATE AND LOCAL REGULATIONS. MEASURES SHOULD BE TAKEN TO DESIGN THE CIRCUIT IN SUCH A WAY THAT IT WILL ALWAYS WORK WHEN THE MEDICAL EQUIPMENT IS POWERED. THE CUSTOMER IS SOLELY RESPONSIBLE FOR THE IMPLEMENTATION OF THE EPOs AND THEIR ASSOCIATED CIRCUITS AND MUST MAKE THE FINAL DETERMINATION CONSIDERING ALL SITE CONDITIONS AND REGULATORY FACTORS.

UNLESS OTHERWISE NOTED, ALL ITEMS LISTED IN THIS SCHEDULE SHALL BE SUPPLIED AND INSTALLED BY CUSTOMER/CONTRACTOR.

GO-SIM
REV 14

PROJECT MANAGER: JASON BOSWELL TEL: (919) 368-5780 VMAIL: (800) 727-7156 EXT: FAX: EMAIL: JASON.BOSWELL@SIEMENS-HEALTHINEERS.COM		SIEMENS	
2202476R DATED 08/28/23 APPROVED BY CUSTOMER FOR FINALS		CENTRAL HARNETT HOSPITAL	
		215 BRIGHTWATER DR, LILLINGTON, NC 27546 FLOOR: GROUND/ ROOMNO: CT SIM - SOMATOM GO.OPEN PRO	
08/28/23	2202476R DATED 08/28/23 APPROVED BY CUSTOMER FOR FINALS	PROJECT #: 2202476	SHEET: E-501
ALL RIGHTS ARE RESERVED.		SHEET 7 OF 7	DRAWN BY: J. DRAMIS
SCALE: AS NOTED		REF. #: 30267651	DATE: 08/28/23

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Radiation Shielding Design Verification

Varian TrueBeam Linear Accelerator Vault

6-, 10-, 15-MV, and 6-, 10-MV FFF X-ray beams

Accommodation of SRS, SRT, and SBRT modalities



Cape Fear Valley Health
Harnett Cancer Center
Lillington, NC
Report prepared by Alice Cheung, MS, DABR
Phone: (803)-528-0159
NC Reg# S108172
September 28, 2023

Basic shielding parameters

1. The barrier adequacy evaluation in this work is based on information given in the NCRP Reports 151, “Structural Shielding Design and Evaluation for Megavoltage X- and Gamma-Ray Radiotherapy Facilities” by the National Council on Radiation Protection and Measurements (NCRP), 2005.
2. Equipment is **Varian TrueBeam** linear accelerator (LINAC) producing 6, 10, 15 MV x-ray beams and flattening filter free (FFF) option for the 6 and 10-MV beam. Table 1 summarizes the operating characteristics of the LINAC’s photon beam modes:

Table 1 Machine operating and clinical usage for all photon beam mode of Varian TrueBeam LINAC.

X-ray beam mode (MV)	Maximum nominal dose rate (MU/min)	Calibration dose* (cGy/MU)	Clinical treatment purpose
6 MV	600	1.000	Conventional, IMRT/VMAT
6 MV FFF	1,400	1.000	SRS/SRT/SBRT
10 MV	600	1.000	Conventional, IMRT/VMAT
10 MV FFF	2,400	1.000	SRS/SRT/SBRT
15 MV	600	1.000	Conventional

*Calibration dose condition is defined at a reference depth in a water phantom for the reference field size of (10×10) cm² at the reference source-to-surface distance (SSD) or source-axis distance (SAD) of 100 cm, according to the physicist’s specification.

3. **Workload (W)** at the Harnett Cancer Center was estimated based on past patient volumes and is projected for future growth as follows under the conservatively safe assumptions in this Report:
 - a. **Patient loads:** 41 treatments per day, 5 treatment days per week, 50 treatment weeks per year.
 - b. **6-MV IMRT/VMAT workload:** 20 treatments per day, using fully intensity modulated radiotherapy (IMRT) or volumetric modulated arc therapy (VMAT) of 6-MV photon radiation to the isocenter dose of 330 cGy per patient at the maximum nominal dose rate of 600 MU per minute
 - c. **6-MV-FFF Stereotactic workload:** 20 treatments per year, using stereotactic body radiotherapy (SBRT) with VMAT with an isocenter dose of 3,500 cGy per patient at the maximum nominal dose rate of 1,400 MU per minute; using stereotactic radiosurgery (SRS) with an isocenter of 6,250 cGy per patient at the maximum nominal dose; using stereotactic radiotherapy (SRT) with an isocenter dose of 3,500 cGy per patient at the maximum nominal dose rate.
 - d. **10-MV-FFF Stereotactic workload:** 10 treatments per year, using stereotactic body radiotherapy (SBRT) with VMAT with an isocenter dose of 3,500 cGy per patient at the maximum nominal dose rate of 2,400 MU per minute using stereotactic radiotherapy (SRT) with an isocenter dose of 3,750 cGy per patient at the maximum nominal dose rate.
 - e. **10 MV IMRT/VMAT workload:** 1 treatment per day, using fully intensity modulated radiotherapy (IMRT) or volumetric modulated arc therapy (VMAT) of 10-MV photon radiation to the isocenter dose of 330 cGy per patient at the maximum nominal dose rate of 600 MU per minute
 - f. **15-MV 3D-CRT workload:** 20 treatments per day, using 3D conformal radiotherapy (3D-CRT) method of 15-MV x rays to the isocenter dose of 330 cGy per patient at the maximum nominal dose rate of 600 MU per minute (A conservative measure assumes all 3D-CRT treatments use 15-MV beams versus a mixture of 6-MV, 10-MV, and 15-MV x rays in reality).

- g. **6-MV and 10-MV QA workload:** accounting for all pertinent daily, monthly, and annual radiation QA procedures as well as IMRT/VMAT patients' QAs per year.
 - h. **6-MV FFF and 10-MV FFF QA workload:** accounting for all pertinent daily, monthly, and annual radiation QA procedures as well as stereotactic patients' QAs per year.
 - i. **10-MV and 15-MV QA workload:** accounting for all pertinent daily, monthly, and annual radiation QA procedures only.
 - j. **Physics workload:** accounting for commissioning, servicing, and maintenance work.
4. Based on the assumptions stated above in section 3, Table II summarizes the weekly workload (dose in Gy per week) calculated for each photon beam mode and technique used. The sum of clinical (treatment and treatment QA) and physics workload equals to the **primary-beam workload (W_p)** for each beam mode.

Table II Weekly workload (Gy/wk) for each photon beam mode and the technique used at the HCC

Beam mode	Conventional (Gy/wk)	IMRT/VMAT (Gy/wk)	SRS/SRT (Gy/wk)	Treatment QA (Gy/wk) ¹	Physics (Gy/wk) ²	Sum (Gy/wk)
6 MV	0.0	330.0	0.0	26.4	57.0	413.4
6 MV FFF	0.0	0.0	47.5	39.0	101.0	187.5
10 MV	0.0	16.5	0.0	1.3	57.0	74.8
10 MV FFF	0.0	0.0	35.0	14.0	44.0	93.0
15 MV	330.0	0.0	0.0	0.0	57.0	387.0

¹Treatment QA workload accounts for radiation delivered in the pre-treatment QA for special techniques including VMAT and SRS/SRT.

²Physics workload accounts for radiation delivered in the daily, monthly, and annual QA as well as new machine commissioning, service engineering, and LINAC's maintenance.

5. **Leakage radiation workload (W_l)** accounts for IMRT procedures that typically use small fields shaped by multi-leaf collimators (MLCs) and conventional SRS/SRT procedures using cones with narrow openings. The IMRT factor (C_l) of 5 was used for conventional IMRT/VMAT and 15 was used for SRS/SRT to obtain the corresponding leakage radiation workload. Table III summarizes the primary and leakage radiation workloads estimated for each beam mode of the TrueBeam LINAC.

Table III Primary and leakage radiation workloads for each photon beam mode used for the planned techniques

Beam mode	Primary radiation workload W_p (Gy/wk)	Leakage radiation workload W_l (Gy/wk)
6 MV	413.4	1839.0
6 MV FFF	187.5	1398.5
10 MV	74.8	146.1
10 MV FFF	93.0	779.0
15 MV	387.0	387.0
Total	1155.7	4549.6

6. **Use factor (U)** is the fraction of a primary-beam workload directed towards a given primary barrier. Table IV shows the use factor assigned to each barrier composing the treatment vault of the new LINAC.

Table IV Use factor (U) for each barrier type for shielding verification calculation in this report.

Use factor (U)	Barrier type
1/4	Primary wall
1/4	Primary ceiling or floor
1/20	Off vertical on ceiling or floor
1	All secondary barriers

7. **Occupancy factor (T)** reflects the degree of occupancy in an area adjacent to a treatment room while a radiation beam is turned on. NCRP-recommended occupancy values for guidance in shielding calculation are attached in Appendix of this report. Based on these suggested values, Table V shows the occupancy factor (T) of each adjoining area at each barrier location illustrated in Figure 1. Each area or location is assigned a controlled or uncontrolled area status based on the occupants who work routinely, or not, with or around the radiation sources.

Table V Specified locations and types of barriers as well as occupancy factors and area types at each barrier location.

Barrier location	Barrier type	Adjoining area	Occupancy factor (T)	Area type
A	Primary	Future Vault/ Outdoor	1/20	Uncontrolled
A1 & A2	Secondary	Future Vault/ Outdoor	1/20	Uncontrolled
B	Primary	Future CT/Outdoor	1/20	Uncontrolled
B1 & B2	Secondary	Future CT/Outdoor	1/20	Uncontrolled
C	Secondary	Control Room	1	Controlled
C1 & C2	Secondary	Storage Closet	1/20	Uncontrolled
D	Secondary	Outdoor	1/20	Uncontrolled
E	Primary	Outdoor/Roof	1/40	Uncontrolled
E1 & E2	Secondary	Outdoor/Roof	1/40	Uncontrolled
V	Secondary	Vault Door	1/8	Controlled

8. The location of the **isocenter** for the new TrueBeam LINAC is planned to be in the vault as depicted in the Appendix A2, A3, and A4 and roughly depicted in Figure 1. Table VI The designed thickness in **ordinary concrete** of each barrier is shown in the table.

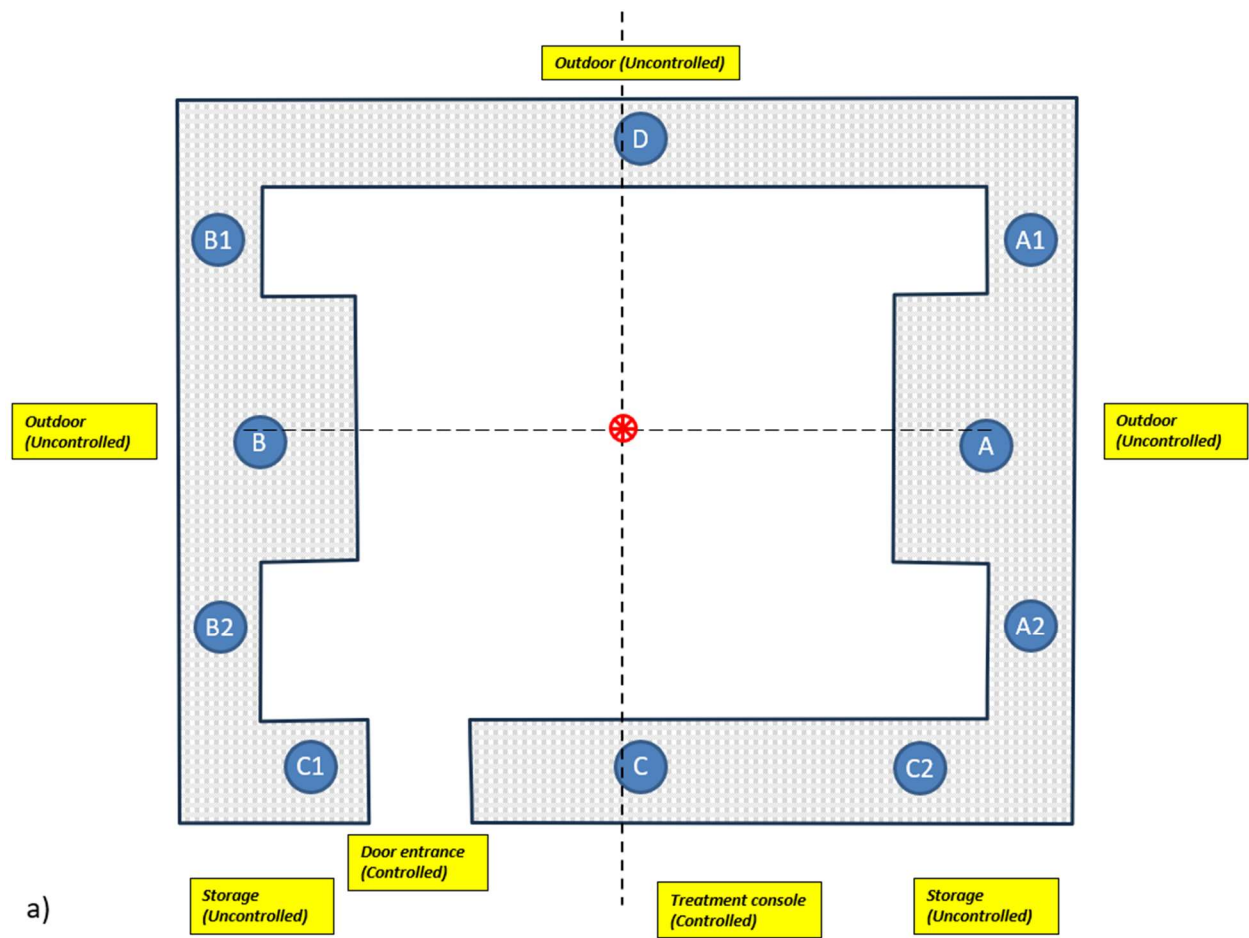
Table VI Designed barrier thickness in ordinary concrete at each barrier location.

Barrier location	Designed barrier thickness in ordinary concrete ¹	
A (Primary)	8'-0" (or 96")	243.8 cm (or 2.44 m)
A1, A2 (Secondary)	3'-9" (or 45")	114.3 cm (or 1.14 m)
B (Primary)	8'-0" (or 96")	243.8 cm (or 2.44 m)
B1, B2 (Secondary)	3'-9" (or 45")	114.3 cm (or 1.14 m)
C (Secondary)	4'-7" (or 55")	139.7 cm (or 1.40 m)
D (Secondary)	3'-9" (or 45")	114.3 cm (or 1.14 m)
E (Primary)	5'-10" (or 70")	177.8 cm (or 1.78 m)
E1 (Secondary)	5'-0" (or 60")	152.4 cm (or 1.52 m)
E2 (Secondary)	2'-6" (or 30")	76.2 cm (or 0.76 m)
V (Secondary) ²	Designed with Pb and 5% BPE as shown in Figure 3	

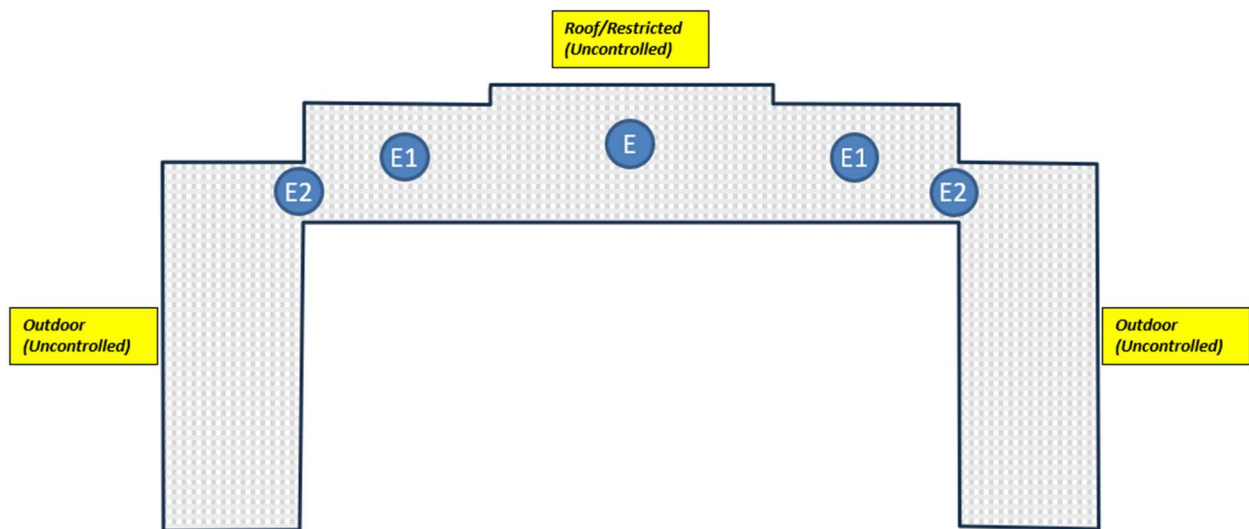
¹Ordinary concrete has a density of 147lb/ft³ or 2.35 g/cm³

²Vault door shall be made of Lead and 5% BPE and encased in stainless steel

9. **Simplified floor and ceiling plans** are reproduced in Figure 1 on the detailed construction designs shown in Appendix (A.1 to A.4) in this report. Each sectional view indicates each barrier location with the given symbol and the immediate area at each location.
10. **Shielding materials** involved in this project include:
- ordinary concrete** with physical density of 147 lb/ft³ (or 2.35 g/cm³);
 - polyethylene with 5% boron by weight, known as **borated polyethylene (BPE)**;
 - lead** with physical density of 709 lb/ft³ (or 11.36 g/cm³).
 - steel** with physical density of 7.87 g/cm³
11. **A direct-shielded door** manufactured by Nelco will be used in the treatment vault. Figure 3 shows the basic design of the door, including the major shielding components and their designed thicknesses. Several construction requirements of the direct door include:
- Motorized sliding door approach** is used to control the opening and closing of the room.
 - Sliding door must be either electrically or hydraulically driven.
 - The door shall be at least **0.25" steel/7" lead/ 13" BPE (5% boron)/3" lead/0.25" steel**.
 - The door **MUST** overlap the concrete entrance by 10 x the actual gap between door and wall on both sides of the door and 7" at the top.
 - In addition, **2"-thick x 25"- long lead and 4"-thick x lap length polyethylene (5% boron) strips** are embedded in the concrete at the door opening on both right and left sides, as shown in Figure 3. The lead and BPE strips must be flush with the concrete wall.



a)



b)

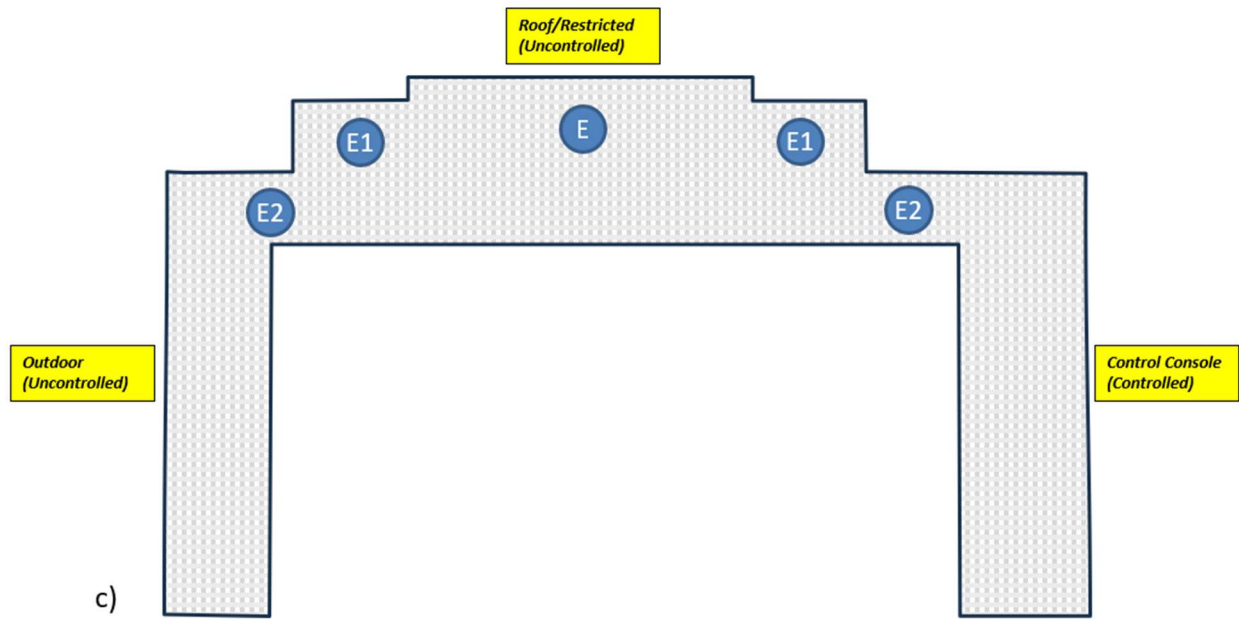


Figure 1 Simplified floor (part a) and ceiling (parts b and c) plans of the LINAC's treatment vault. Part b) depicts length and widths in the East and West direction and c) depicts the length and widths in the North South (not drawn to scale.)

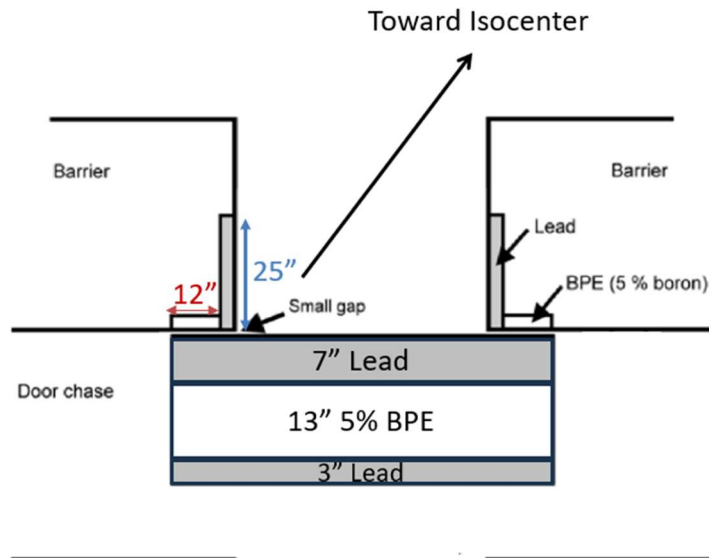


Figure 2 Direct shielded door made of 10" lead/13" 5% BPE total of 30" shell (not drawn to scale.)

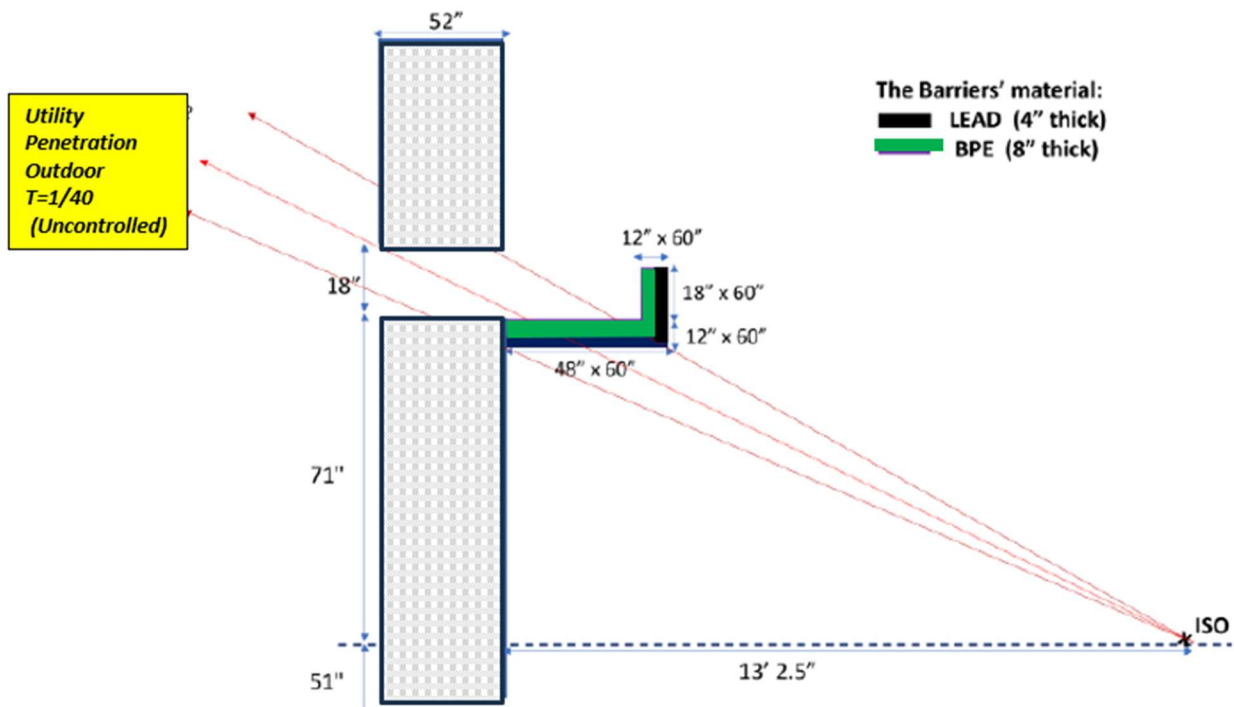


Figure 3 Utility opening shielding

12. **Utilities opening shielding** designed by El Bentefour, PhD will be used in the treatment vault. Figure 3 shows the basic design of the shielding around the opening.
13. Barrier thickness is typically specified in terms of **tenth value layer (TVL)**. TVL depends on the energy of accelerator, radiation type and quality, and the type of shielding material.
14. NCRP 151 Barrier shielding calculation formalism as detailed in the Appendix.

Dose equivalent calculation verification results

15. **Table VII** shows the calculated dose equivalents per week at locations A, B, and E beyond the primary barriers of the treatment rooms (see Figure 1). At these three locations, all dose components (primary and secondary) as well as the total weekly dose equivalents were below the NCRP-recommended dose limits (of 20 μSv per week for uncontrolled areas and 100 μSv per week for controlled areas).

Table VII Verification of weekly dose equivalents beyond primary barriers.

Barrier location	Adjoining area	Barrier thickness in concrete ¹	Area type ²	U	T	d^3	H_{prim}^4 ($\mu\text{Sv}/\text{wk}$)	H_{sec}^5 ($\mu\text{Sv}/\text{wk}$)	Limit ($\mu\text{Sv}/\text{wk}$)	Status
A	Future Vault/ Outdoor	8'-0"	UC	1/4	1/20	6.40 m	0.14	0.02	20	Pass
B	Future CT/Outdoor	8'-0"	UC	1/4	1/20	6.40 m	0.14	0.02	20	Pass
E ⁶	Outdoor/Roof	5'-10"	UC	1/4	1/40	5.65 m	3.92	0.37	20	Pass

¹ Perpendicular (L) barrier thickness. Physical density of ordinary concrete is 147 lb per cubic foot or 2.35 g per cubic cm.

² UC: uncontrolled area; C: controlled area.

³ Distance (d) between the x-ray target and location point 30 cm beyond the given primary barrier.

⁴ The primary-radiation dose equivalent (H_{prim}) is the sum of the weekly dose equivalents for all primary x-ray beams accounting for their corresponding primary workloads (see Table III) and shielding parameters involved for the given primary barrier (see Tables IV to VII).

⁵ The secondary-radiation dose equivalent (H_{sec}) is the sum of the weekly dose equivalents for both patient-scattered and leakage radiations for all x-ray beams accounting for their corresponding primary and leakage workloads (see Table III) as well as shielding parameters involved for the given barrier transmission calculation (see Tables IV to VII).

⁶ Restricted area to minimize occupancy while linear accelerators are operational

16. **Table VIII** shows the calculated dose equivalents per week at all locations of interest beyond the secondary barriers of the treatment rooms (see Figure 1). The total weekly secondary-radiation dose equivalents were below the NCRP-recommended dose limits (of 20 μSv per week for uncontrolled areas and 100 μSv per week for controlled areas) at all secondary-barrier locations.

Table VIII Verification of weekly dose equivalents beyond secondary barriers.

Barrier location	Adjoining area	Barrier ¹ thickness in concrete	Area type ²	U	T	d_{sec} ³	H_{sec} ⁴ ($\mu\text{Sv}/\text{wk}$)	Limit ($\mu\text{Sv}/\text{wk}$)	Status
A1	Future Vault/ Outdoor	3'-9"	UC	1	1/20	6.91 m	2.07	20	Pass
A2	Future Vault/ Outdoor	3'-9"	UC	1	1/20	6.91 m	2.07	20	Pass
B1	Future CT/Outdoor	3'-9"	UC	1	1/20	6.91 m	2.07	20	Pass
B2	Future CT/Outdoor	3'-9"	UC	1	1/20	6.91 m	2.07	20	Pass
C	Control Room	4'-7"	C	1	1	5.72 m	3.82	100	Pass
C1	Storage Closet	4'-7"	UC	1	1/20	7.66 m	1.27E-03	20	Pass
C2	Storage Closet	4'-7"	UC	1	1/20	8.99 m	4.62E-08	20	Pass
D	Outdoor	3'-9"	UC	1	1/40	4.73 m	0.99	20	Pass
E1	Outdoor/Roof	5'-0"	UC	1	1/40	5.01 m	0.02	20	Pass
E2	Outdoor/Roof	2'-6"	UC	1	1/40	4.89 m	1.26	20	Pass
V	Vault Door	See Figure 3	C	1	1/8	4.05 m	11.51	100	Pass

¹ Perpendicular (\perp) barrier thickness. Physical density of ordinary concrete is 147 lb per cubic foot or 2.35 g per cubic cm. Physical density of V300 is 300 lb per cubic foot or 5.0 g per cubic cm.

² UC: uncontrolled area; C: controlled area.

³ Distance from the isocenter to the point protected 0.3 m beyond a secondary barrier.

⁴ The sum of the weekly dose equivalents for both patient-scattered and leakage radiations for all x-ray beams accounting for primary and leakage workloads as well as shielding parameters involved for the given barrier transmission calculation.

17. **Table IX** shows the calculated time-averaged dose equivalents (TADR) in-any-one-hour at all locations of interest beyond the primary and secondary barriers of the treatment room. The total TADRs in any-one-hour were below the NRC-recommended dose limit of 20 μSv and 100 μSv for uncontrolled and controlled areas respectively at all primary- and secondary-barrier locations.

Table IX Verification of the calculated time averaged dose equivalent (TADR) in-any-one-hour (R_h) at different barrier locations of interest.

Location	Barrier type	M^1	Primary radiation			Secondary radiation			Total			Status
			IDR ($\mu\text{Sv/hr}$)	R_w ($\mu\text{Sv/wk}$)	R_h (μSv)	IDR_{ps}^2 ($\mu\text{Sv/hr}$)	IDR_L^3 ($\mu\text{Sv/hr}$)	R_w ($\mu\text{Sv/wk}$)	R_h (μSv)	R_h (μSv)	Limit (μSv)	
A	P	1.2	27.84	3.70	0.11	3.15	0.001	0.35	0.010	0.12	20	Pass
A1	S	1.2	-	-	-	73.16	7.342	39.88	1.155	1.15	20	Pass
A2	S	1.2	-	-	-	73.16	7.342	39.88	1.155	1.15	20	Pass
B	P	1.2	27.84	3.70	0.11	3.15	0.001	0.35	0.010	0.12	20	Pass
B1	S	1.2	-	-	-	73.16	7.342	39.88	1.155	1.15	20	Pass
B2	S	1.2	-	-	-	73.16	7.342	39.88	1.155	1.15	20	Pass
C	S	1.2	-	-	-	0.00	3.927	3.82	0.111	0.11	100	Pass
C1	S	1.2	-	-	-	0.00	0.030	0.03	0.001	0.00	20	Pass
C2	S	1.2	-	-	-	0.00	0.000	0.00	0.000	0.00	20	Pass
D	S	1.2	-	-	-	0.07	38.172	39.68	1.149	1.15	20	Pass
E	P	1.2	1951.53	217.23	6.29	151.92	0.140	14.77	0.428	6.72	20	Pass
E1	S	1.2	-	-	-	1.38	0.253	0.77	0.022	0.02	20	Pass
E2	S	1.2	-	-	-	27.28	38.803	50.25	1.455	1.45	20	Pass
V	S	1.2	-	-	-	137.82	0.067	47.23	1.368	1.37	100	Pass

¹ The ratio of maximum allowable number of patients to the average number of patients treated in an hour (accounting for setup times.)

² The instantaneous dose rate for patient-scattered radiation transmitting through the given barrier (accounting for all x-ray beam energies and corresponding maximum operating dose rates.)

³ The instantaneous dose rate for leakage radiation transmitting through the given barrier (accounting for all x-ray beam energies and corresponding maximum dose operating rates.)

18. **Table X** shows the parameters used to determine the primary barrier width based on the conservative safest assumption and formulation discussed in the Appendix. The planned width's dimensions of 144 inches, as shown in the actual construction drawings (see Appendices A.1 to A.4), at the primary barrier locations, is greater than the required 137.2 inches and 143.8 inches for the primary wall and roof respectively per the NCRP 151 formulation for a maximum jaw aperture of 50.0 (or $35 \times \sqrt{2}$) cm, when projected at the isocenter level.

Table X Verification of the primary barrier's width.

Primary barrier location ¹	A/B		E	
	Inch (")	m	Inch (")	m
d_{NH}	183.37	4.66	100.60	2.56
h	124.00	3.15	194.00	4.93
d_N		5.83		6.17
f		0.35		0.35
t_p	96.00	2.44	70.00	1.78
t_s	45.00	1.14	30.00	0.76
w (calculated/expected)	137.17	3.48	143.80	3.65
w (planned/actual)	144.00	3.66	144.00	365.76
Difference in w	6.83	0.17	0.20	0.50

¹ The primary barrier wall location is specified in Figure 1.

² The parameters and symbols used for the barrier width calculations are specified in primary barrier calculation methods in the appendix

19. **Table XI** Skyshine from the primary roof barrier was also evaluated. Architectural drawings were not available for review. Assumptions were made regarding the height between roof and 2nd and 3rd floors.

Table XII Calculation of side scatter radiation from the primary roof barrier to adjacent 2nd and 3rd floors.

Side Scatter Radiation			
Location	IDR _{ss} (μSv/hr)	Limit (μSv/hr)	Status
2 nd Floor	1.96	20	Pass
3 rd Floor	1.77	20	Pass

Other remarks (and NCRP recommendations)

20. Construction drawings shown in Appendices A.1 to A.4 were assumed to represent the treatment room of the new TrueBeam LINAC.
21. **No change of the isocenter location or additional penetrations will** be made in the shielding without review by a qualified radiological physicist.
22. **Five to six room** air changes per hour are required to prevent the build-up of ozone and other noxious gasses in the treatment room.
23. Conduits, water pipes, etc. should be routed under the floor slab. Small (1" to 3" diameter) pipes, conduits, and water lines can be routed through a secondary barrier if placed near the concrete ceiling slab. Large penetrations will require additional shielding.
24. There should be a conduit running between the console and treatment room for placement of physics equipment cables no more than 4" diameter. The conduit can pass under the floor slab at a secondary barrier location in barrier C as seen in Figure 1a of this report, and up into the room. Alternatively, the **physics pipe may be placed within the secondary barrier angled down and away from isocenter by 45 degrees towards the floor.**
25. Please refer to the manufacturer's (Varian's) specifications for details on base frame, conduits, water pipes, incoming electricity etc.
26. Special care MUST be taken by the general contractor during construction of the concrete wall at the door (see Figure 2). The concrete wall must be cast so that it is **plumb within 1/8" over vertical** to minimize variations in the door gap with height above the floor.
27. The following essential safety devices should be installed during the construction of the LINAC's treatment vault:
 - a. **Beam-on indicator light** centered over the access door;
 - b. **Door interlock (dual micro) switches** that interrupt the beam "on" status, causing the useful beam to go to the "off" condition when the door to the radiation vault is opened and prevent the beam to turn "on" again while the door remains opened, until the equipment is manually activated from the control console following the closing of the door and restoration of the interlock circuit;
 - c. **Two independent TV systems** for remote viewing of the accelerator vault from the console;
 - d. **An intercom system** for mutual communication between the patient in the treatment room and the personnel outside in the console area;
 - e. Several **emergency switches** located at accessible locations inside the vault;
 - f. **A last person-out switch** located inside the vault near the maze door;
 - g. **An interior radiation monitor** mounted inside the room (visible to personnel from outside) and **a remote radiation monitor** mounted outside the room.
28. Several safety-related measures regarding the direct-shield door should be considered and taken during construction and routine clinical operations. These measures include:
 - a. Gypsum board should not be mounted between the exterior surface of the concrete wall and the door.

- b. It is recommended that the local physicist determine the door overlap, gap, and dimensions of the heavy density concrete blocks when the door is installed. **Correct placement of the heavy density concrete MUST be checked at this time.**
 - c. **Safety plans** should be made for retrieving the patient in the event of an electrical failure or failure of the driving mechanism of the door.
 - d. **Periodic inspection and routine preventive maintenance programs** should be instituted for the automatic door opening and closing system.
29. It is recommended by the NCRP-151 that a qualified expert carry out a physical inspection of the new facility during construction. The inspection should include an evaluation of at least the following items:
- a. Thickness of concrete;
 - b. Thickness of metal shielding and BPE used for neutron shielding;
 - c. Thickness of metal behind recesses in the concrete (e.g., laser boxes);
 - d. HVAC shielding baffle if used;
 - e. Location and size of conduit or pipe used for electrical cable of any type;
 - f. Verification that the shielding design has been followed.
30. A summary document outlining the results of the construction inspection shall be prepared by the qualified expert and forwarded, as appropriate, to the facility owner, architecture firm involved in the construction, and the governing regulatory agency.

Conclusions

The planned barrier thicknesses and direct-shielded door was adequate for the installation of new Varian TrueBeam LINAC. The barrier and door shielding adequacy accommodated MLC-based SRS/SRT/SBRT techniques.

The actual construction of the new treatment vault will strictly follow the construction floor and ceiling plans shown in Appendices A.1 to A.4, after the verification of dose equivalent and TADR calculations shown in this report. No modification of the shielding design including the materials and dimensions used in the barrier and door shielding as well as installations of other adjunct components, such as HVAC, electrical, and water conduits, is allowed without due discussion with and approval of qualified physicists and radiation safety officer at the Cape Fear Valley Health.

References

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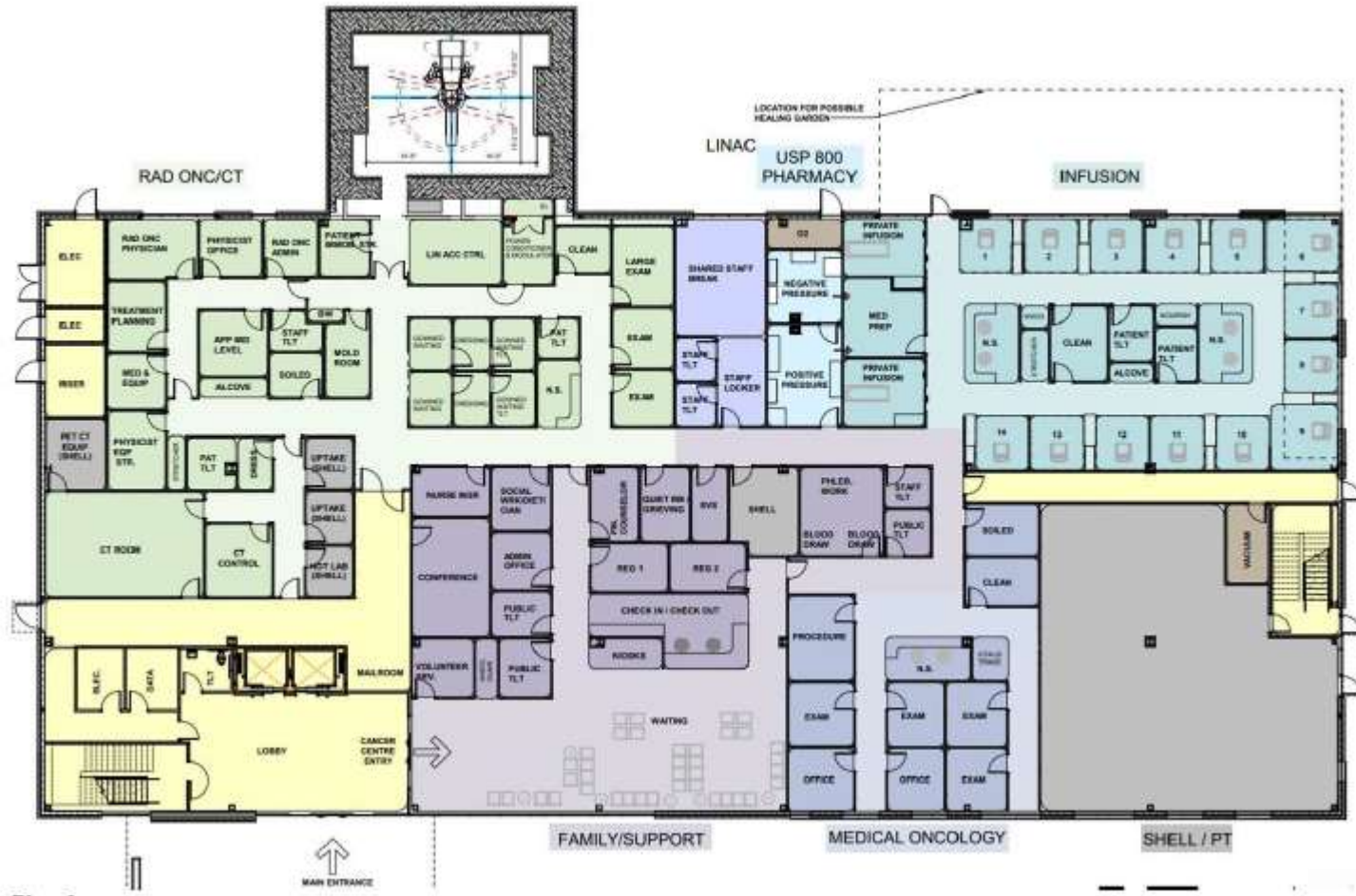
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NCRP (2005). National Council on Radiation Protection and Measurements. *Structural shielding design and evaluation for megavoltage x- and gamma-ray radiotherapy facilities*. NCRP Report No. 151 (National Council on Radiation Protection and Measurements, Bethesda, Maryland).

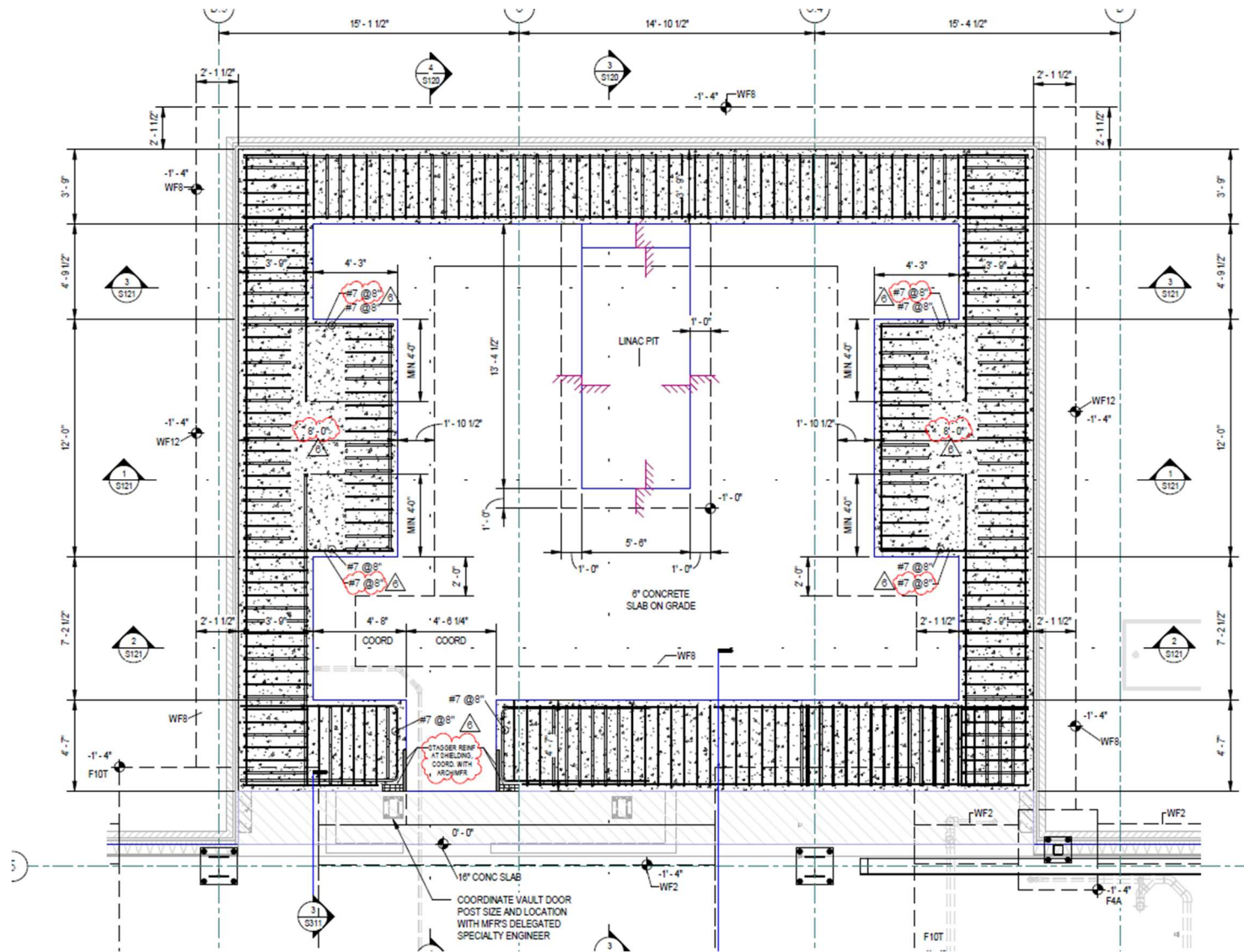
NRC (2005). U.S. Nuclear Regulatory Commission. “Standards for protection against radiation,” 10 CFR 20, <https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/> (accessed August 2020) (U.S. Government Printing Office, Washington).

Appendix

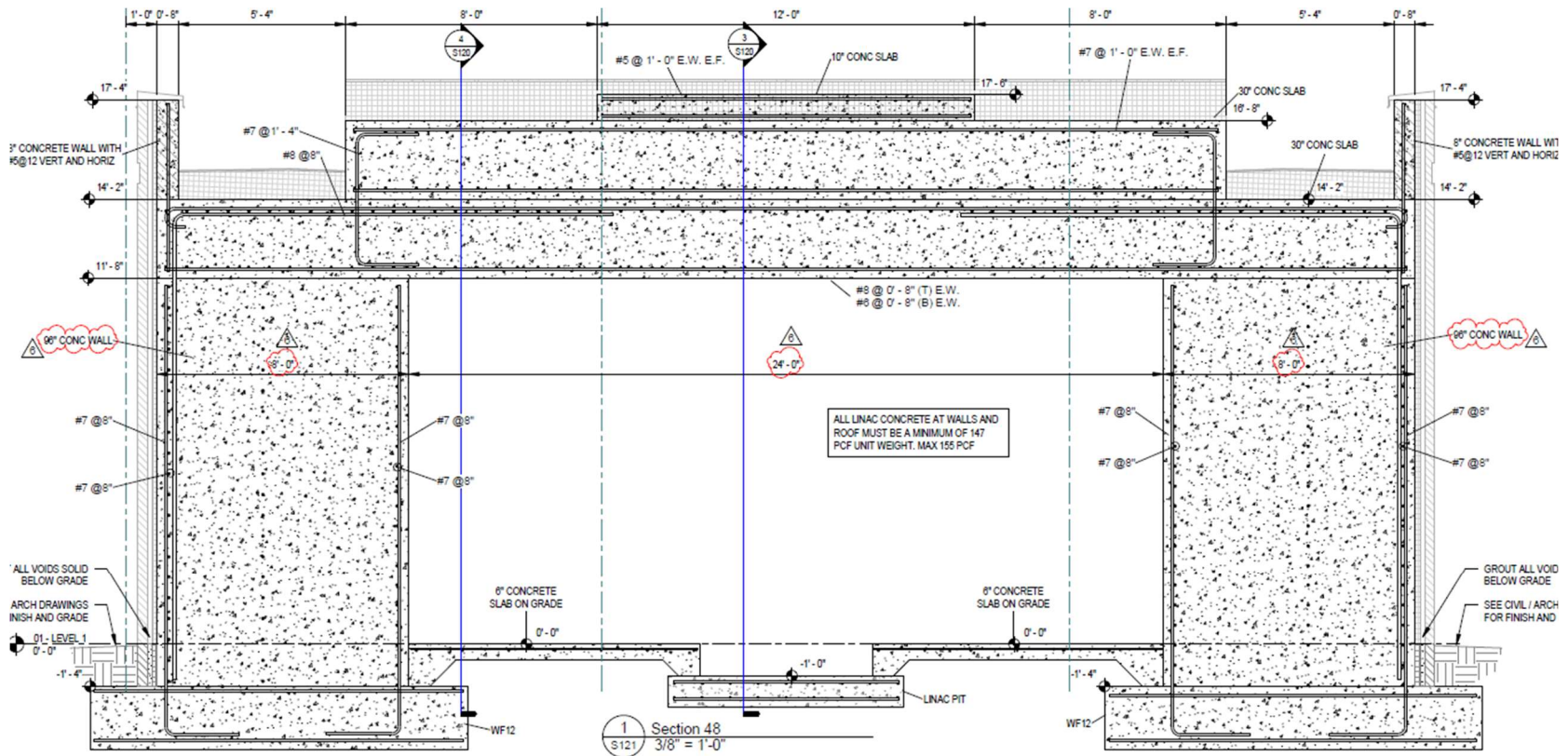
Architectural Drawings



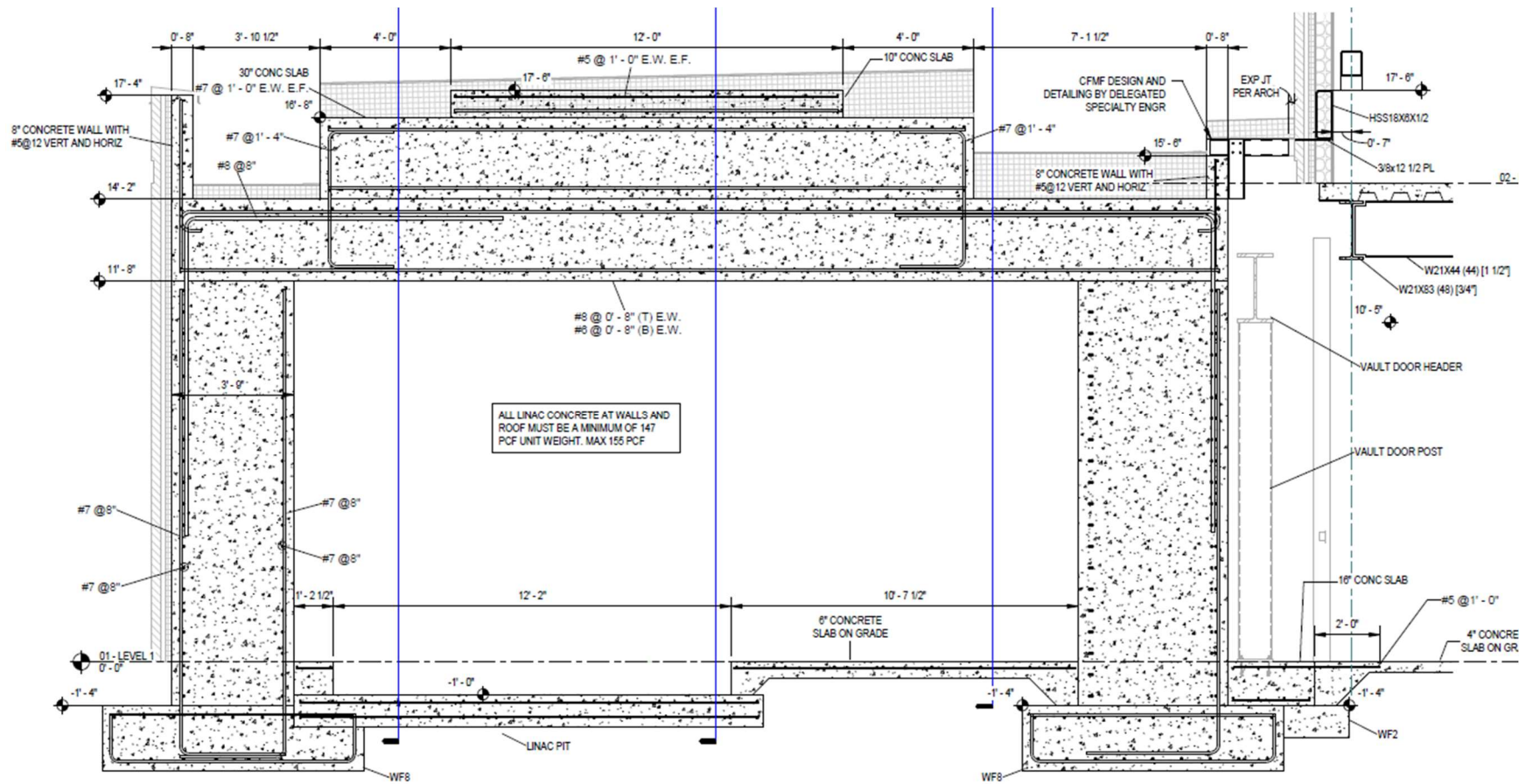
A1. Floor plan of the new TrueBeam LINAC's vault indicating the immediate areas surrounding the radiation facility.



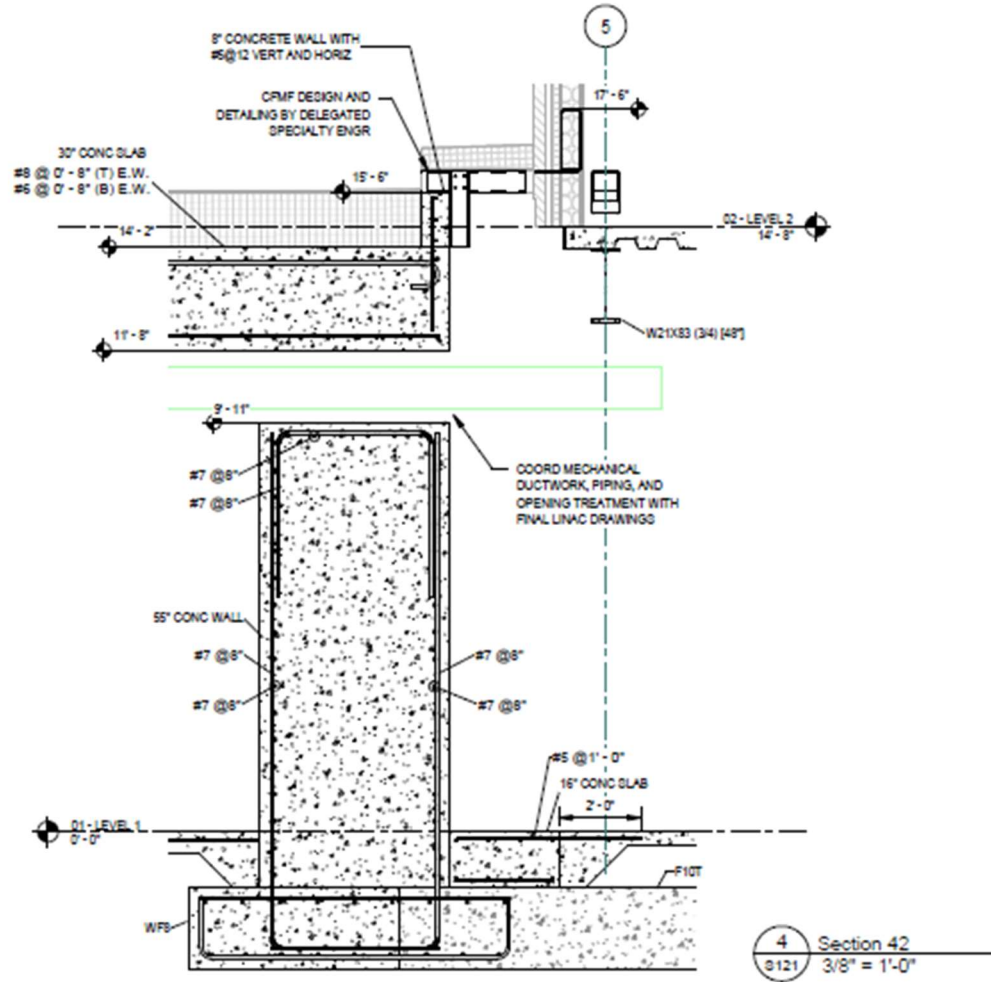
A2. Floor plan of the new TrueBeam LINAC's vault detailing the vault dimensions and barrier thicknesses for all involved primary and secondary barriers. See note in read regarding primary barrier thickness.



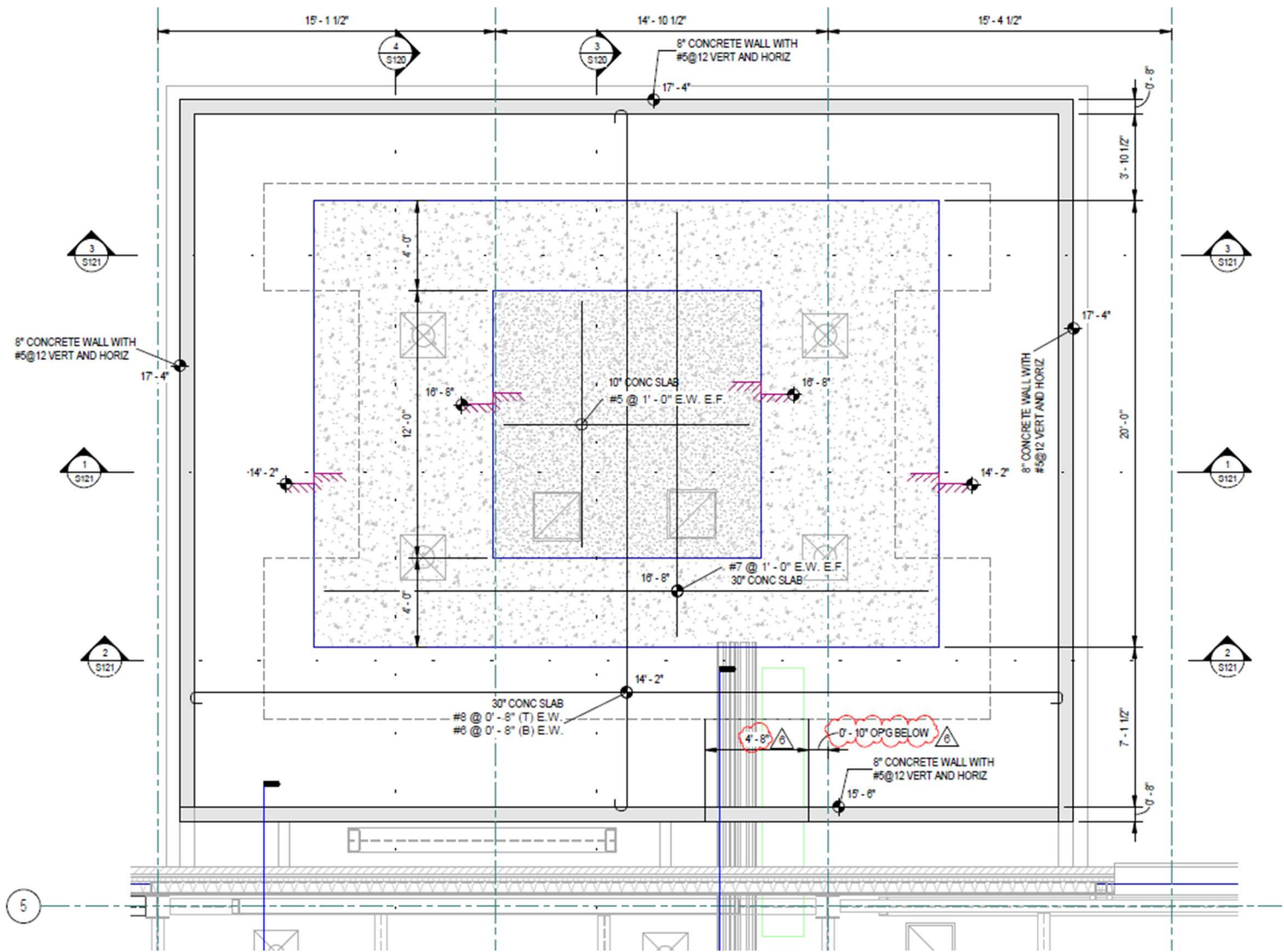
A3. Ceiling plan (East to West view) of the new TrueBeam LINAC's vault detailing the vault dimensions and barrier thicknesses for all involved primary and secondary barriers. See note in read regarding primary barrier thickness.



A4. Ceiling plan (North to South view) of the new TrueBeam LINAC's vault detailing the vault dimensions and barrier thicknesses for all involved primary and secondary barriers.



A5. Utility penetration



A6. LINAC Roof Plan

NCRP 151 Data

TABLE B.1—**Suggested** occupancy factors^a (for use as a guide in planning shielding when other sources of occupancy data are not available).

Location	Occupancy Factor (<i>T</i>)
Full occupancy areas (areas occupied full-time by an individual), <i>e.g.</i> , administrative or clerical offices; treatment planning areas, treatment control rooms, nurse stations, receptionist areas, attended waiting rooms, occupied space in nearby building	1
Adjacent treatment room, patient examination room adjacent to shielded vault	1/2
Corridors, employee lounges, staff rest rooms	1/5
Treatment vault doors ^b	1/8
Public toilets, unattended vending rooms, storage areas, outdoor areas with seating, unattended waiting rooms, patient holding areas, attics, janitors' closets	1/20
Outdoor areas with only transient pedestrian or vehicular traffic, unattended parking lots, vehicular drop off areas (unattended), stairways, unattended elevators	1/40

^aWhen using a low occupancy factor for a room immediately adjacent to a therapy treatment vault, care *shall* be taken to also consider the areas further removed from the treatment room. The adjacent room may have a significantly higher occupancy factor and may therefore be more important in shielding design despite the larger distances involved.

^bThe occupancy factor for the area just outside a treatment vault door can often be assumed to be lower than the occupancy factor for the work space from which it opens.

TABLE B.2—Primary-barrier TVLs for ordinary concrete (2.35 g cm^{-3}), steel (7.87 g cm^{-3}), and lead (11.35 g cm^{-3}) (suggested values in centimeters).^a

Endpoint Energy (MV) ^b	Material	TVL ₁ (cm)	TVL _e (cm)
4	Concrete	35	30
	Steel	9.9	9.9
	Lead	5.7	5.7
6	Concrete	37	33
	Steel	10	10
	Lead	5.7	5.7
10	Concrete	41	37
	Steel	11	11
	Lead	5.7	5.7
15	Concrete	44	41
	Steel	11	11
	Lead	5.7	5.7
18	Concrete	45	43
	Steel	11	11
	Lead	5.7	5.7
20	Concrete	46	44
	Steel	11	11
	Lead	5.7	5.7
25	Concrete	49	46
	Steel	11	11
	Lead	5.7	5.7
30	Concrete	51	49
	Steel	11	11
	Lead	5.7	5.7
Co-60	Concrete	21	21
	Steel	7.0	7.0
	Lead	4.0	4.0

^aConcrete values are based on a conservatively safe adaptation from Nelson and LaRiviere (1984) with extrapolation to 4 MV, and use of Kirn and Kennedy (1954) for 30 MV. Lead and steel TVLs are conservatively safe values adapted from NCRP Report No. 49 (NCRP, 1976) and Wachsmann and Drexler (1975).

^bEndpoint energy based on values from Cohen (1972).

TABLE B.7—TVLs for leakage radiation in ordinary concrete (suggested values in centimeters).^a

Endpoint Energy (MV) ^b	TVL ₁ (cm)	TVL _e (cm)
4	33	28
6	34	29
10	35	31
15	36	33
18	36	34
20	36	34
25	37	35
30	37	36
Co-60	21	21

^aData for TVL₁ and TVL₂ are based on a conservatively safe adaptation of the 90 degrees (80 to 100 degrees) values of Nelson and LaRiviere (1984) and graphical extrapolations to 4 MV and 30 MV. NCRP Report No. 49 (NCRP, 1976) values used for ⁶⁰Co.

^bEndpoint energy based on values from Cohen (1972).

A8. TVLs for primary and leakage radiations, as recommended in the NCRP No. 151 Report.

TABLE B.5a—TVLs in concrete (centimeters) for patient-scattered radiation at various scatter angles, based on Figures 10 and 15 in NCRP Report No. 49 (NCRP, 1976). Values are valid for shielding design purposes and are conservatively safe in nature.^a

Scatter Angle (degrees)	TVL (cm)							
	Co-60	4 MV	6 MV	10 MV	15 MV	18 MV	20 MV	24 MV
15	22	30	34	39	42	44	46	49
30	21	25	26	28	31	32	33	36
45	20	22	23	25	26	27	27	29
60	19	21	21	22	23	23	24	24
90	15	17	17	18	18	19	19	19
135	13	14	15	15	15	15	15	16

^aValues derived from NCRP (1976) for ⁶⁰Co and 6 MV, and from Abrath *et al.* (1983) for 18 MV. Extrapolation to 24 MV was accomplished by comparison to primary TVLs.

TABLE B.5b—TVL₁ and TVL₂ in lead (centimeters) for patient-scattered radiation at various scatter angles (based on Nogueira and Biggs, 2002).^a

Scatter Angle (degrees)	4 MV		6 MV		10 MV	
	TVL ₁ (cm)	TVL ₂ (cm)	TVL ₁ (cm)	TVL ₂ (cm)	TVL ₁ (cm)	TVL ₂ (cm)
30	3.3	3.7	3.8	4.4	4.3	4.5
45	2.4	3.1	2.8	3.4	3.1	3.6
60	1.8	2.5	1.9	2.6	2.1	2.7
75	1.3	1.9	1.4	1.9	1.5	1.9
90	0.9	1.3	1.0	1.5	1.2	1.6
105	0.7	1.2	0.7	1.2	0.95	1.4
120	0.5	0.8	0.5	0.8	0.8	1.4

^aBiggs, P.J. (2005). Personal communication (Massachusetts General Hospital, Boston). Update of values in Nogueira and Biggs (2002).

A9. TVLs for patient-scattered radiations, as recommended in the NCRP No. 151 Report.

TABLE B.4—Scatter fractions (a) at 1 m from a human-size phantom, target-to-phantom distance of 1 m, and field size of 400 cm² (McGinley, 2002; Taylor et al., 1999).

Angle (degrees)	Scatter Fraction (a)			
	6 MV	10 MV	18 MV	24 MV
10	1.04×10^{-2}	1.66×10^{-2}	1.42×10^{-2}	1.78×10^{-2}
20	6.73×10^{-3}	5.79×10^{-3}	5.39×10^{-3}	6.32×10^{-3}
30	2.77×10^{-3}	3.18×10^{-3}	2.53×10^{-3}	2.74×10^{-3}
45	1.39×10^{-3}	1.35×10^{-3}	8.64×10^{-4}	8.30×10^{-4}
60	8.24×10^{-4}	7.46×10^{-4}	4.24×10^{-4}	3.86×10^{-4}
90	4.26×10^{-4}	3.81×10^{-4}	1.89×10^{-4}	1.74×10^{-4}
135	3.00×10^{-4}	3.02×10^{-4}	1.24×10^{-4}	1.20×10^{-4}
150	2.87×10^{-4}	2.74×10^{-4}	1.20×10^{-4}	1.13×10^{-4}

B. SUPPORTING DATA (TABLES) / 163

A10. Scatter fractions recommended in the NCRP No. 151 Report.

TABLE B.8a—Differential dose albedo (wall-reflection coefficient). Multiply each table entry by 10^{-3} (e.g., the entry 3.4 means 3.4×10^{-3}). Normal incidence on ordinary concrete, for bremsstrahlung and monoenergetic photons.^a

0 Degree Incidence	Angle of Reflection or Scatter (degrees) from Concrete (measured from the normal)				
	0	30	45	60	75
Source					
30 MV	3.0	2.7	2.6	2.2	1.5
24 MV	3.2	3.2	2.8	2.3	1.5
18 MV	3.4	3.4	3.0	2.5	1.6
10 MV	4.3	4.1	3.8	3.1	2.1
6 MV	5.3	5.2	4.7	4.0	2.7
4 MV	6.7	6.4	5.8	4.9	3.1
Co-60	7.0	6.5	6.0	5.5	3.8
0.5 MeV	19.0	17.0	15.0	13.0	8.0
0.25 MeV	32.0	28.0	25.0	22.0	13.0

^aTable values are based on evaluation of the data from the following sources: Figures 49 and 50b in IAEA (1979), Lo (1992), and Figure 4.14(b) in NCRP (2003). The available data in the references noted were put on a common graph and conservatively safe values were selected. However, there are large uncertainties (on the order of $\pm 50\%$) in albedo values due to both the calculations and the interpolations.

TABLE B.8b—Differential dose albedo (wall reflection coefficient). Multiply each table entry by 10^{-3} (e.g., the entry 4.8 means 4.8×10^{-3}). 45 degree angle of incidence, ordinary concrete, for bremsstrahlung and monoenergetic photons.^a

45 Degree Incidence	Angle of Reflection or Scatter (degrees) from Concrete (measured from the normal)				
	0	30	45	60	75
Source					
30 MV	4.8	5.0	4.9	4.0	3.0
24 MV	3.7	3.9	3.9	3.7	3.4
18 MV	4.5	4.6	4.6	4.3	4.0
10 MV	5.1	5.7	5.8	6.0	6.0
6 MV	6.4	7.1	7.3	7.7	8.0
4 MV	7.6	8.5	9.0	9.2	9.5
Co-60	9.0	10.2	11.0	11.5	12.0
0.5 MeV	22.0	22.5	22.0	20.0	18.0
0.25 MeV	36.0	34.5	31.0	25.0	18.0

^aTable values are based on evaluation of the data from the following sources: Figures 49 and 50b in IAEA (1979) and Figure 4.14(b) in NCRP (2003). The available data in the references noted were put on a common graph and conservatively safe values were selected. However, there are large uncertainties (on the order of $\pm 50\%$) in albedo values due to both the calculations and the interpolations.

A11. Differential dose albedo for normal and 45°-incidence of x rays on ordinary concrete, as recommended in the NCRP No. 151 Report.

TABLE B.9—Neutron dose equivalent (H_0) at 1.41 m from the target per unit absorbed dose of x rays at the isocenter ($mSv Gy^{-1}$) and total neutron source strength (Q_n) emitted from accelerator head. A graph of Q_n as a function of nominal endpoint energy for the data in Table B.9 is presented in Figure B.1.

Vendor	Model	Endpoint Energy (MV)		H_0	Q_n	Reference
		Nominal	Using AAPM (1983)	mSv / Gy	Neutrons per gray ($\times 10^{12}$)	
Varian	1800	18	16.6	1.02 – 1.6	1.22	McGinley (2002)
	1800	15		0.79 – 1.3	0.76	McGinley (2002)
	1800	10		0.04	0.06	McGinley (2002)
	2100C ^a	18			0.96	Followill <i>et al.</i> (2003)
	2100C ^a	18			0.87	Followill <i>et al.</i> (2003)
	2300CD	18			0.95	Followill <i>et al.</i> (2003)
	2500	24			0.77	Followill <i>et al.</i> (2003)
Siemens	KD	20	16.5	1.1 – 1.24	0.92	McGinley (2002)
	MD ^a	15		0.17	—	McGinley (2002)
	MD2	10			0.08	Followill <i>et al.</i> (2003)
	MD ^a	15			0.2	Followill <i>et al.</i> (2003)
	KD	18			0.88	Followill <i>et al.</i> (2003)
	Primus	10			0.02	Followill <i>et al.</i> (2003)
	Primus ^a	15			0.12	Followill <i>et al.</i> (2003)
Philips/Electa	Primus ^a	15			0.21	Followill <i>et al.</i> (2003)
	SL25 ^a	25	22	2.0	2.37	McGinley (2002)
	SL20	20	17	0.44	0.69	McGinley (2002)
	SL20	18			0.46	Followill <i>et al.</i> (2003)
	SL25	18			0.46	Followill <i>et al.</i> (2003)
GE	SL25 ^a	25			1.44	Followill <i>et al.</i> (2003)
	Saturne41	12	11.2	0.09	0.24	McGinley (2002)
	Saturne41	15	12.5	0.32	0.47	McGinley (2002)
	Saturne43 ^a	18	14.0	0.55	1.50	McGinley (2002)
	Saturne43 ^a	18			1.32	Followill <i>et al.</i> (2003)
	Saturne43	25	18.5	1.38	2.4	McGinley (2002)

^aTwo separate units of the same model and nominal endpoint energy.

A12. Neutron dose equivalent (H_0) at 1.41 m from the target per unit x-ray absorbed dose at isocenter (mSv per Gy) and total neutron source strength (Q_n) emitted from the treatment head as a function of nominal x-ray energy and LINAC model, as recommended in the NCRP No. 151 Report.

Barrier shielding calculation formalism

1. **Primary barrier transmission factor** (B_p) is given by:

$$B_p = (P \times d_p^2) / (W_p \times U \times T),$$

Where

P is the permissible dose per week (in cGy/wk or Gy/wk),

d_p is the distance from the x-ray target to the point protected (in m),

W_p is the primary-beam workload (in cGy/wk or Gy/wk) at 1 m from the x-ray target,

U is the use factor that the primary beam is directed at the barrier in question,

T is the occupancy factor at the protected location.

2. **Secondary barrier transmission factor required for radiation scattered by patient** (B_{ps}) is given by:

$$B_{ps} = \{P / (a(\theta) \times W_p \times T)\} \times d_{sca}^2 \times d_{sec}^2 \times (400/F),$$

Where

$a(\theta)$ is the scatter fraction at patient scatter angle θ ,

d_{sca} is the distance from the x-ray target to the patient or scattering surface (in m),

d_{sec} is the distance from the scattering object to the point protected (in m),

F is the field area at mid-depth of the patient at isocenter (in cm²).

3. **Secondary barrier transmission factor of leakage radiation alone** (B_L) is given by:

$$B_L = (P \times d_L^2) / (L_f \times W_L \times U \times T),$$

Where

L_f is leakage fraction taken as 0.1% or 10^{-3} of the primary useful beam at 1 m from the source,

d_L is the distance from the x-ray target to the point protected (in m) at the given head position,

W_L is the IMRT-modified leakage radiation workload (in cGy/wk or Gy/wk).

4. Based on NCRP-151 recommendation and 10 CFR Part 20, the **shielding design goal or weekly permissible dose equivalent** (P) is given by:

g. 0.1 mSv/wk (or 5 mSv/yr) for controlled (C) areas;

h. 0.02 mSv/wk (or 1 mSv/yr) for uncontrolled (UC) areas.

5. **The weekly time-averaged dose equivalent rate** (R_w) is the TADR averaged over a 40-hour work week. For primary barrier, the weekly TADR (in Sv/wk) is given by:

$$R_w = (IDR \times W_p \times U) / \dot{D}_0,$$

Where

IDR is the instantaneous dose rate (in Sv/hr) measured with the machine operating at the absorbed dose output rate \dot{D}_o ,

\dot{D}_o is the absorbed dose output rate at 1 m (Gy/hr).

6. **The weekly TADR for secondary barriers** has contributions from both patient-scattered and leakage radiations and is given by:

$$R_w = (IDR_{ps} \times W_p \times U) / \dot{D}_0 + (IDR_L \times W_L) / \dot{D}_0 \text{ and}$$

$$IDR_{ps} = IDR_{tot} - IDR_L,$$

Where

IDR_{tot} is the instantaneous dose rate (in Sv/hr) measured at the protected point (30 cm beyond the secondary barrier) in the PRESENCE of the phantom at the isocenter,

IDR_L is the instantaneous dose rate (in Sv/hr) measured at the protected point (30 cm beyond the secondary barrier) in the ABSENCE of the phantom at the isocenter,

IDR_{ps} is the instantaneous dose rate (in Sv/hr) measured at the protected point (30 cm beyond the secondary barrier) due to patient-scattered radiation.

7. **The integrated TADR in-any-one-hour** (R_h) derives from the maximum number of patient treatments that could possibly be performed in-any-one-hour when the time for setup is taken into account and is related to the weekly TADR (R_w) by:

$$R_h = (M/40)R_w,$$

Where

M is the ratio of the maximum number (N_{max}) in-any-one-hour with due consideration of set-up time to the average number (N_h) of patient treatments per hour and is always ≥ 1 .

8. The **US Nuclear Regulatory Commission** (NRC) specifies that the dose equivalent in any unrestricted area from external source not exceed 0.02 mSv in-any-one-hour. In other words, the dose equivalent in any one hour of operation in uncontrolled areas will be 0.02 mSv or less, with the occupancy factor set equaled to one (i.e., $T = 1$).

9. **The total dose equivalent at the direct shielded door** (H_{tot}) consists of six dose components and is given by :

$$H_{tot} = H_{WS} + H_{LS} + H_{ps} + H_{LT} + H_n + H_\gamma,$$

Where

H_{WS} is the weekly dose equivalent due to scatter of the primary beam from the room surfaces,

H_{LS} is the weekly dose equivalent due to head-leakage photons scattered by the room surfaces,

H_{ps} is the weekly dose equivalent due to primary beam scattered from the patient,

H_{LT} is the weekly dose equivalent due to leakage radiation transmitted through the intervening barrier,

H_{nT} is the weekly dose equivalent due to neutron leakage radiation transmitted through the intervening barrier and neutron capture gammas,

H_γ is the weekly dose equivalent due to neutron capture gammas in the shielding material

The jamb nearest to isocenter of the direct shielded door jamb is predominantly from a single wall scatter from the primary barrier closest to the direct shielded door.

Thus, H_{tot} near side can be approximated by:

$$H_{tot, \text{near side}} = H_{WS}$$

The jamb far from isocenter of the direct shielded door is treated as a secondary barrier with short slant thickness at the corner of the entrance. Additional shielding is typically required to compensate.

10. **The wall-scattered radiation dose equivalent** (H_s) results from radiation scattered to maze door when the primary beam strikes the primary wall at location A, as shown in Figure 3. It is given by:

$$H_{WS} = f (W_p \times U_B \times \alpha_0 \times A_0 \times \alpha_z \times A_z) / (d_h \times d_r \times d_z)^2,$$

Where

W_P is the primary-beam workload (in Gy/wk),

U_B is the use factor for the primary barrier at location A,

α_0 is the reflection coefficient at the first scattering surface of cross-sectional area A_0 (in m^2),

α_z is the reflection coefficient for second reflection from the inner maze scattering surface of cross-sectional area A_z (in m^2),

d_h is the perpendicular distance (in m) from the target to the first reflection surface,

d_r is the distance (in m) from the beam center at the first reflection to the point b (see Figure 2) on the mid-line of the maze,

d_z is the centerline distance (in m) along the maze from the point b to the maze door.

f is the fraction of the primary beam transmitted through the patient (assuming a field size of 40×40 cm^2 and a phantom size of $40 \times 40 \times 40$ cm^3).

11. **The head-leakage, wall-scattered radiation dose equivalent** (H_{LS}) results from head-leakage radiation striking the inner maze wall of area A_1 (see Figure 2) and undergoing a single scatter before reaching the maze door. It is calculated by:

$$H_{LS} = [W_L \times L_f \times U_B \times \alpha_1 \times A_1] / (d_{sec} \times d_{zz})^2,$$

Where

α_1 is the reflection coefficient for scatter of leakage radiation from the inner maze wall of sectional area A_1 (in m^2), seen from the outer-entrance maze door,

d_{sec} is the distance (in m) from the average target position at isocenter to the center of the inner maze wall area A_1 ,

d_{zz} is the total centerline distance (in m) along the maze length to the maze door.

12. **The patient-scattered radiation dose equivalent** (H_{ps}) results from patient-scattered radiation undergoing a single scatter from the inner maze wall of area A_1 (see Figure 2) to the maze door. It is given by:

$$H_{ps} = [a(\theta) \times W_P \times U_B \times \{F/400\} \times \alpha_1 \times A_1] / (d_{sca} \times d_{sec} \times d_{zz})^2,$$

Where

α_1 is the reflection coefficient for scatter of the patient-scattered radiation from the inner maze wall of sectional area A_1 (in m^2) seen from the maze door,

d_{sec} is the distance (in m) from the patient at isocenter to the center of the inner maze wall area A_1 ,

d_{zz} is the total centerline distance (in m) along the maze length to the maze door.

13. **The head-leakage, barrier-transmission radiation dose equivalent** (H_{LT}) results from head-leakage radiation transmitted through intervening maze wall directly to the treatment room door (see Figure 2). It is given by:

$$H_{LT} = (W_L \times L_f \times U_B \times B) / d_L^2,$$

Where

B is the transmission factor for intervention of maze wall along the path-length traced by d_L ,

d_L is the distance (in m) from the x-ray target through the maze wall to the maze door.

14. **The weekly dose equivalent** (H_γ) at the maze door due to neutron capture gamma rays is given by:

$$H_\gamma = W_L \times h_\varphi,$$

Where

h_φ is the dose equivalent from the neutron capture gamma rays at the inside maze entrance, i.e., at point b in Figure 2, per unit x-ray absorbed dose at isocenter.

15. **The neutron capture-ray dose equivalent** (h_φ) at the inside maze entrance is given by:

$$h_\varphi = K \times \varphi_b \times 10^{-(d_2/TVD)},$$

Where

φ_b is the total neutron fluence (in m^{-2}) at location point b per unit x-ray absorbed dose at isocenter,

d_2 is the distance (in m) from the point b to the maze door (i.e., $d_2 = d_z$),

TVD is the tenth-value distance (~ 3.9 m for 15 MV x rays and ~ 5.4 m for 18 to 25 MV x rays).

16. **The total neutron fluence** (φ_b) at the inside maze entrance (point b in Figure 2) per unit x-ray absorbed dose at isocenter is given by:

$$\varphi_b = \frac{\beta Q_n}{4\pi d_1^2} + \frac{5.4\beta Q_n}{2\pi S_r} + \frac{1.3Q_n}{2\pi S_r},$$

Where

β is the transmission factor for neutrons penetrating the head shielding (1 for lead shielding and 0.85 for tungsten shielding),

d_1 is the distance (in m) from the isocenter to location point b,

Q_n is neutron source strength in neutrons emitted from accelerator head per gray of x-ray absorbed dose at isocenter,

S_r is total surface area (in m^2) of the treatment room.

17. **The weekly dose equivalent due to neutrons** (H_n) at the maze door is given by:

$$H_n = W_L \times D_n,$$

Where

D_n is the neutron dose equivalent at the maze door per unit x-ray absorbed dose at isocenter.

18. **The neutron dose equivalent per unit absorbed dose of x rays at the isocenter** (D_n) is governed by **Kersey's method** and empirically given by:

$$D_n = H_0 \times (S_0/S_1) \times (d_0/d_1)^2 \times 10^{-(d_2/5)},$$

Where

H_0 is the total neutron dose equivalent at a reference distance (d_0) from the target per unit x-ray absorbed dose at isocenter (in mSv/Gy),

S_0 is the cross-sectional area of the inner maze entrance (see Figure 2),

S_1 is the cross-sectional area of the outer maze entrance (see Figure 2),

d_1 is the distance (in m) from the isocenter to the inner maze entrance point b in Figure 2 (i.e., $d_1 = d_{sec}$),

d_2 is the distance (in m) from the point b to the maze door (i.e., $d_2 = d_z$).

19. **Modified Kersey's method**, introduced by Wu and McGinley, accounts for rooms with non-standard surface areas or mazes with exceptional widths and lengths and refines the neutron dose equivalent (D_n) along the maze length by:

$$D_n = 2.14 \times 10^{-15} \times \varphi_n \times \sqrt{(S_0/S_1)} \times [1.64 \times 10^{-(d_2/1.9)} + 10^{-(d_2/TVD)}],$$

Where

φ_n is the neutron fluence per unit x-ray absorbed dose at isocenter (in $n's/m^2/Gy$),

S_0/S_1 is the ratio of inner maze to outer maze cross-sectional areas,

TVD is the tenth-value distance (in m) that varies with the cross-sectional area along the maze (S_1), i.e.,

$$TVD = 2.06 \times \sqrt{S_1}.$$

20. **The total dose equivalent at the far side of maze door from photon leakage and scatter radiation** uses a secondary barrier assumption (see secondary barrier calculation.)

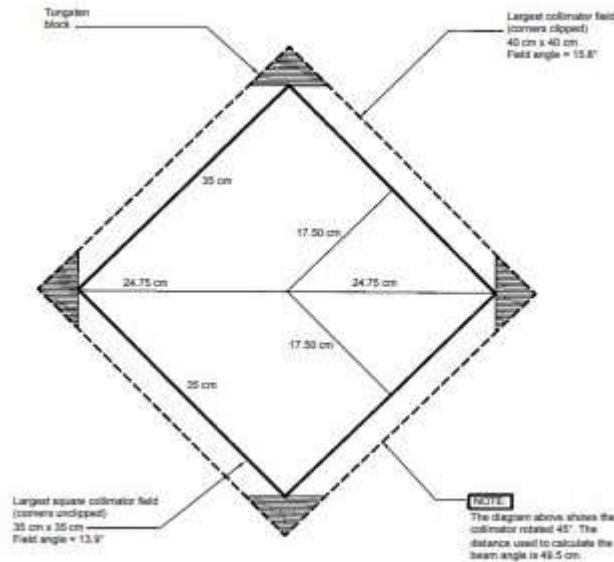


Figure 4 Varian collimator design for largest field size determination

21. **Barrier width (w) for the primary beam** is generally equal to the size of the diagonal of the largest radiation field ($40 \times 40 \text{ cm}^2$ at the isocenter) projected to the primary barrier plus a margin of 1 foot (or 30 cm) to each side. The NCRP Report 151 specifies that:
- If the primary barrier protrudes into the room, as shown in Figures 1 and 2, the maximum field size is calculated on the plane of the inner (or target) side of the secondary barrier.
 - The largest clinical field width at the isocenter is calculated as $40\sqrt{2}$ or 56.6 cm at the isocenter when the LINAC's collimator is rotated 45° from its nominal angular position. On most LINACs, however, the maximum size of the primary beam is limited to 50 cm diameter at the source-surface distance (SSD) of 100 cm, equivalent to a half angle of 14° . For this sake, the maximum radiation field was set as 50 cm diameter at the isocenter level for calculation of primary barrier width in this report (see Figure 3.)
 - The barrier width is determined at the top of the primary barrier intersecting with the ceiling of the treatment vault. Figure 4 demonstrates this specific concept. The intersection line is furthest from the isocenter. The resulting calculated width (w) is maintained constant over the primary-barrier region, i.e., both side walls and ceiling.

- d. Figure 3 illustrates the geometry and parameters involved in the primary barrier width's calculation based on the NCRP's conservative safest assumptions, the **primary barrier width** (**w**) is given by:

$$w = \left(\frac{f}{100\text{cm}}\right) \sqrt{S_1} * d_N + 0.6\text{meters}.$$

$$d_N = \sqrt{h^2 + (d_{NH} - 1)^2} + 1$$

Where h is the meters above isocenter and the distance to the target to the narrow point of the barrier measured horizontally by d_{NH} .

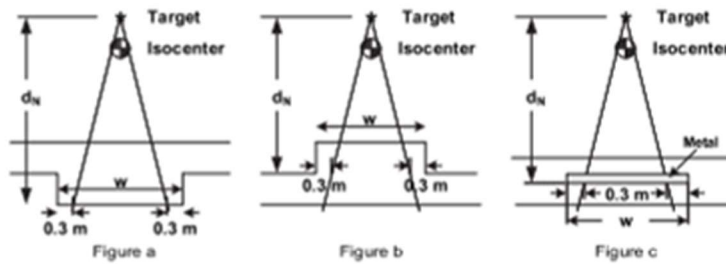


Figure 2-6 Primary barrier width.

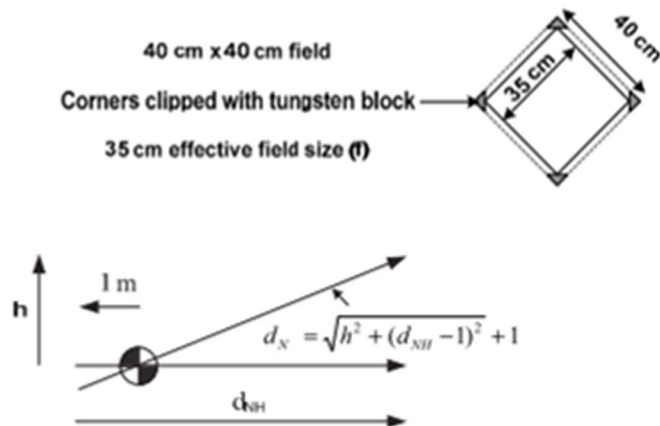


Figure 5 Schematic diagram showing the geometry and parameters for NCRP-151's conservatively safest calculation of the primary barrier wall.



Site Planning Guide For:

Harnett Health Cancer Center Carestream DRX-1 Radiographic System

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These Room Plans are provided by Equipment Vendor for the sole purpose of showing specific information on the equipment to be installed at this facility. The provider of these plans is not responsible for designing or providing room specifications other than what is needed for the successful installation and operation of the Radiographic system.

TRIANGLE X-RAY CO.
Phone: (919)876-6156
Toll Free: (866)763-9729
Fax: (919)872-3986

Dwg No. T2308-10-A-F

Please direct all questions to:
support@trianglexray.com

Harnett Health Cancer Center
Carestream DRX-1 Radiographic System

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General Notes:

- TXC is only responsible for installation of imaging equipment purchased from TXC or equipment contracted to be relocated with TXC. All other construction and room preparation, including millwork, cabinets, sinks, backing for apron racks, networking connections, etc. are to be designed and supplied by others.
- Customer and his General Contractor are responsible for all work in preparing the x-ray room and surrounding area and all costs involved.
- Customer and his Contractor are responsible for the cost and obtaining of all professional fees and all permits, including all building and electrical permits.
- Customer is responsible for obtaining lead shielding requirements from a licensed physicist and/or compliance with local and state regulations.
- Although room lighting is not specified on these plans, it is the responsibility of the purchaser or his architect or electrical Contractor to provide dimming lights in the x-ray room and control booth area as well as convenient wall outlets, strategically placed around the room.
- Ceiling height is indicated on these plans and must be as maintained as stated. If for any reason the minimum ceiling height is unobtainable, it is the responsibility of the Customer or his Contractor to notify TXC Project Management.
- All dimensions are from finished surfaces unless otherwise noted. Accuracy of room dimensions are based upon information provided to the creator of these plans, thus the creator will not accept responsibility for any discrepancies.
- When required by state law, the purchaser is to employ a registered physicist to certify x-ray system and room shielding at the purchaser's expense.
- Any structural backing for equipment support shall be a minimum thickness of 2" wood secured to a minimum of three studs with the face of the backing flush with the line of the studs unless local codes supercede the suggested specifications noted in these plans.
- All construction shall comply with all building codes that have jurisdiction.
- The purchaser, at his expense, shall arrange to have furnished and installed any plumbing, wall, floor or ceiling reinforcing Unistrut, electrical conduit, wire, main switches, panel boards, junction boxes and cover plates, bushings, wire or cable duct or trough specified or required for the satisfactory installation of the x-ray equipment. Locations of electrical boxes may vary slightly due to stud locations. If dimensions aren't specified, then locations are to be within close proximity of item.
- These drawings are supplied to suggest location of x-ray equipment and associated apparatus, electrical wiring details and room arrangements. In preparing these plans, every effort has been made to conform details to the actual equipment expected to be installed. The provider of these plans cannot accept responsibility for any changes made to the equipment or the room or for any damages resulting therefrom. Actual construction drawings should be provided by the purchaser's architect or general Contractor.
- TXC assumes no responsibility for any construction costs, whether or not related to the installation of any x-ray equipment. No work may be performed or any materials furnished at the expense of TXC without a prior authorized, signed purchase order. Equipment listed on Sales quote supersedes the Equipment listed on the Equipment Legend on these plans.



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Site Readiness Requirements

The following general conditions are required prior to the delivery of equipment. These conditions will insure the best possible environment for the installation and protection of computers, electronics, x-ray tubes, image intensifiers, cameras, monitors, and mechanical equipment. Please note if these conditions are not met at the time of delivery, the TXC Project Manager should reschedule the installation start date.

- All necessary approvals, permitting, and shielding reviews required by either state or local governing agencies will be the customer's responsibility. Some states will not allow the installation to begin without prior approval.
- Power available at the designated power cabinet prior to delivery of equipment.
- Walls to be sanded, primed and painted, floor covering installed, ceiling completed, doors hung with finish applied and lead barriers installed.
- HVAC complete, functioning properly and tested prior to equipment delivery.
- Exam room floor under all floor mounted x-ray equipment shall be flat and level to within 0.125" in all directions in a 10' span.
- All vendor base plates, reinforcement plates, and overhead grid installed as designated in Site Planning Guide. It will be the responsibility of the customer's design engineer to furnish recommended methods of anchoring and attachment for applicable TXC x-ray equipment.
- All cable troughs, junction boxes, conduits and raceways correctly sized and installed according to the provided Site Planning Guide. All lighting installed and functioning at the time of delivery. **ALL FLUSH MOUNTED J-BOXES SHOULD HAVE OVERSIZED COVERS AND BE PAINTED TO MATCH THE WALL.**
- Room and immediate vicinity to be dust free and remain so for the duration of the installation.
- Customer supplied PACS, processors, laser imagers, cameras, computers, printers, routers, networks, and network drops are to be installed and verified operational prior to TXC installing image acquisition and processing hardware and software. Additionally, firewalls, backup power sources, virus software and other security software and hardware are the Customer's responsibility to acquire, install, and maintain current (unless prior arrangements have been made for TXC to provide this equipment). TXC will connect to customer installed network drops but assumes no responsibility for proper operation of Customer's network and associated hardware. It is strongly suggested that the Customer retain an IT person to be available for network related issues that may arise during its useful life. TXC is not responsible for computer malfunctions due to Customer or patient's unauthorized use or installation of computer programs for their personal use.
- TXC supplied servers are not allowed to have updates installed without the prior consent of TXC.
- Telephone service and VPN access must be installed and operational prior to installation for remote support.
- It will be the customer's responsibility to provide a clear and unobstructed pathway for delivery of diagnostic devices, including room entry.

Removal of old equipment must be quoted by service. TXC does not dispose of transformers or tubes. Third party disposal service companies are available upon request.



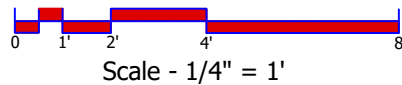
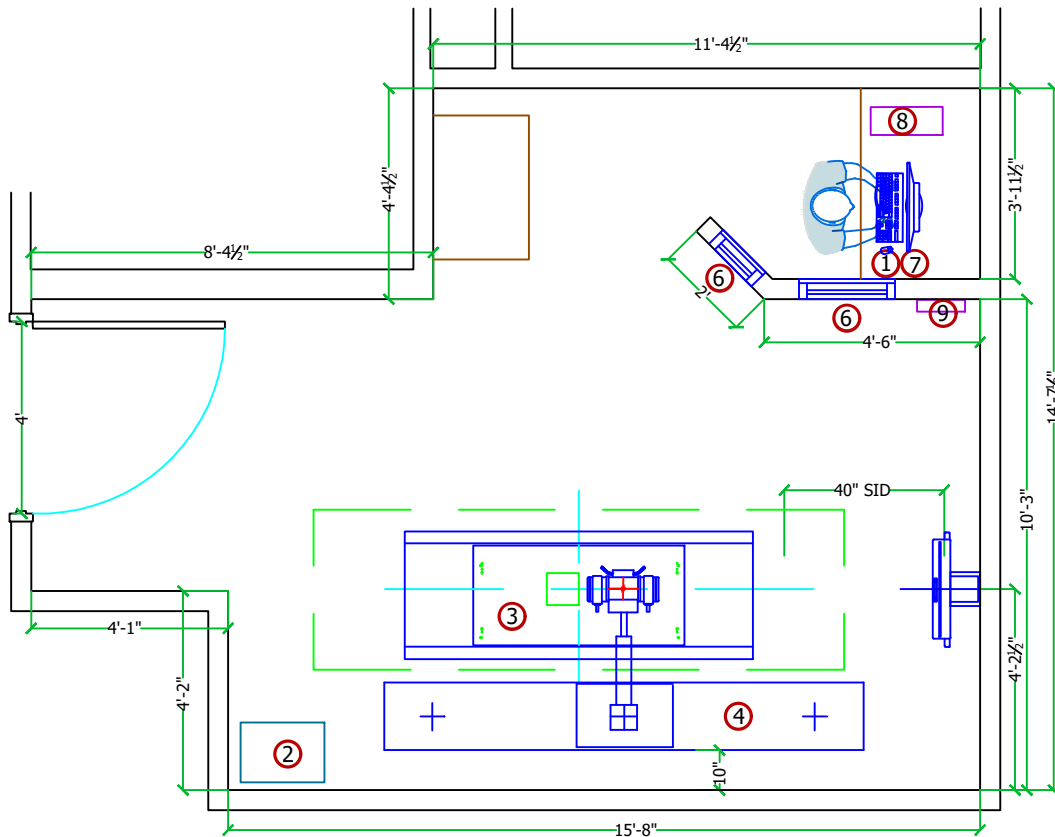
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EQUIPMENT LEGEND					
FUTURE					
EXISTING					
INSTALLED BY CUSTOMER/CONTRACTOR					
FURNISHED BY CUSTOMER/CONTRACTOR					
INSTALLED BY TXC					
FURNISHED BY TXC					
ITEM	DESCRIPTION	WT. (LBS)	BTU'S /HR	DETAIL SHEET	
①	Summit/Acquistion Console and DR Workstation/Monitor/Keyboard	N/A	900	•	•
②	Summit SHF-510-50kw Compact Gen. Cabinet DIM: 20.0" x 18.5" x 43.35"	326	850	•	•
③	Del Medical EV-650 Table DIM: 87" x 32" x Variable"	563	300	•	•
④	Del Medical FMTS Tubestand DIM: 120" x 45" x 85.0"	663	870	•	•
⑤	Del Medical VS-200 Wall Bucky DIM: 25" x 12.25" x 84.0"	200	N/A	•	•
⑥	Lead Window, size determined by customer			•	•
⑦	Carestream DRX-1 DR Workstation	N/A	N/A	•	•
⑧	Carestream DRX Battery Charger DIM: 7" x 18" x 15"	N/A	N/A	•	•
⑨	Carestream DRX Wireless Access Point DIM: 12" x 3" x 18" - Locate 7' AFF	N/A	N/A	•	•

Recommended Ceiling Height - 9'0"
Minimum Ceiling Height - 8'0"



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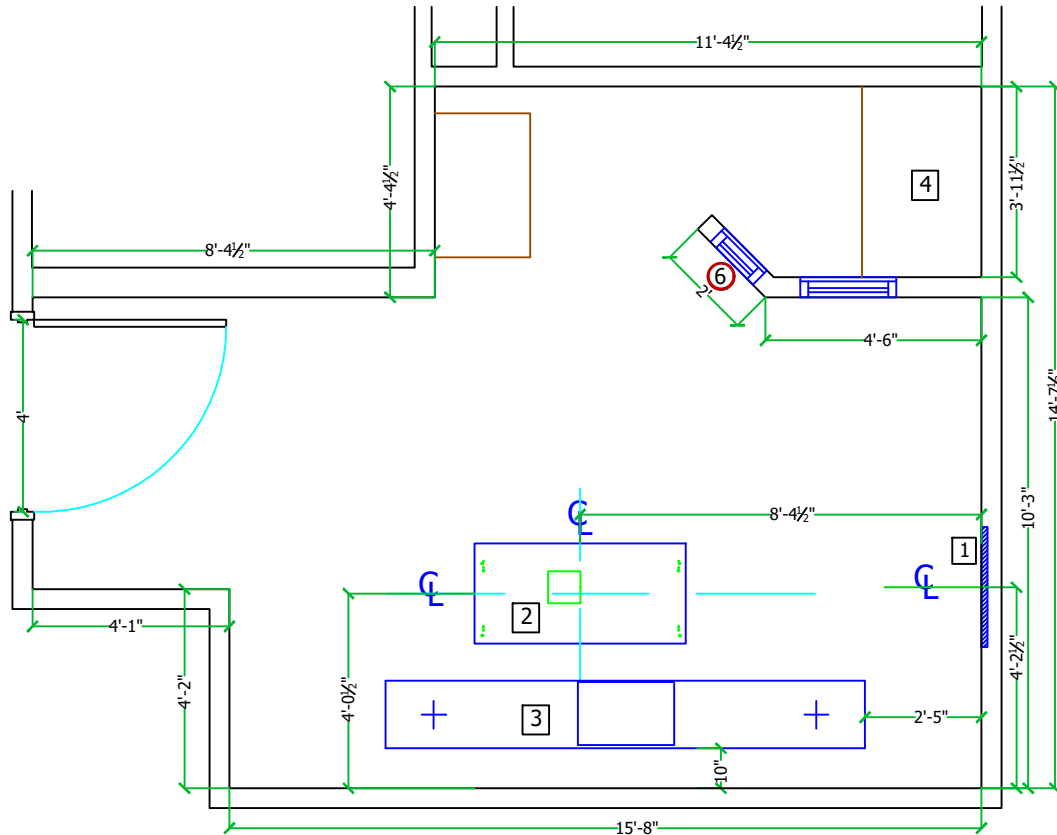
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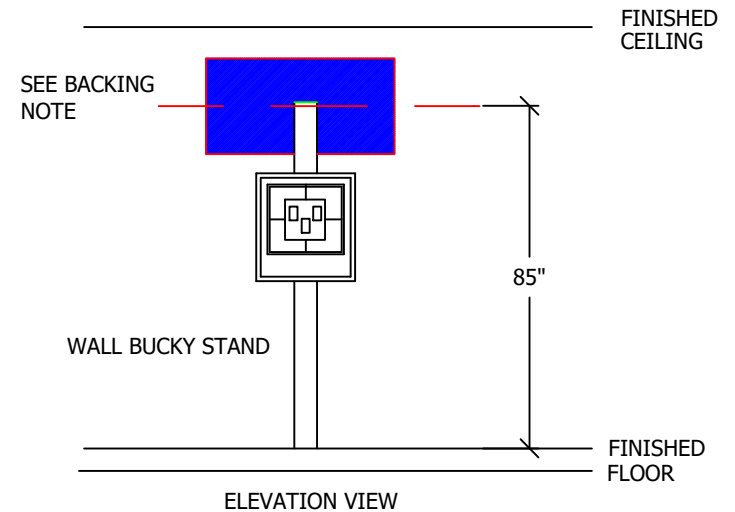
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Structural Layout - Floor & Wall



STRUCTURAL SUPPORT LEGEND	
FUTURE	
EXISTING	
INSTALLED BY CUSTOMER/CONTRACTOR	
FURNISHED BY CUSTOMER/CONTRACTOR	
INSTALLED BY TXC	
FURNISHED BY TXC	
ITEM	DESCRIPTION
1	Wall Mounting Support - Provide 2" x 12" Board behind finished sheet rock attached to at least 2 studs. Centered 85" AFF.
2	Quantum Table Base location.
3	Quantum Floor Mounted Tubestand location.
4	Countertop designed and installed by Customer / Contractor



BACKING NOTE:
 2" x 12" BOARD BACKING IN WALL MOUNTED TO AT LEAST 2 STUDS PER CUSTOMER ENGINEER'S SPECIFICATIONS. DRYWALL OR PLASTER OVER, PAINT TO MATCH ADJACENT WALL. TO SUPPORT 100 LBS. LATERAL PULL.



Scale - 1/4" = 1'



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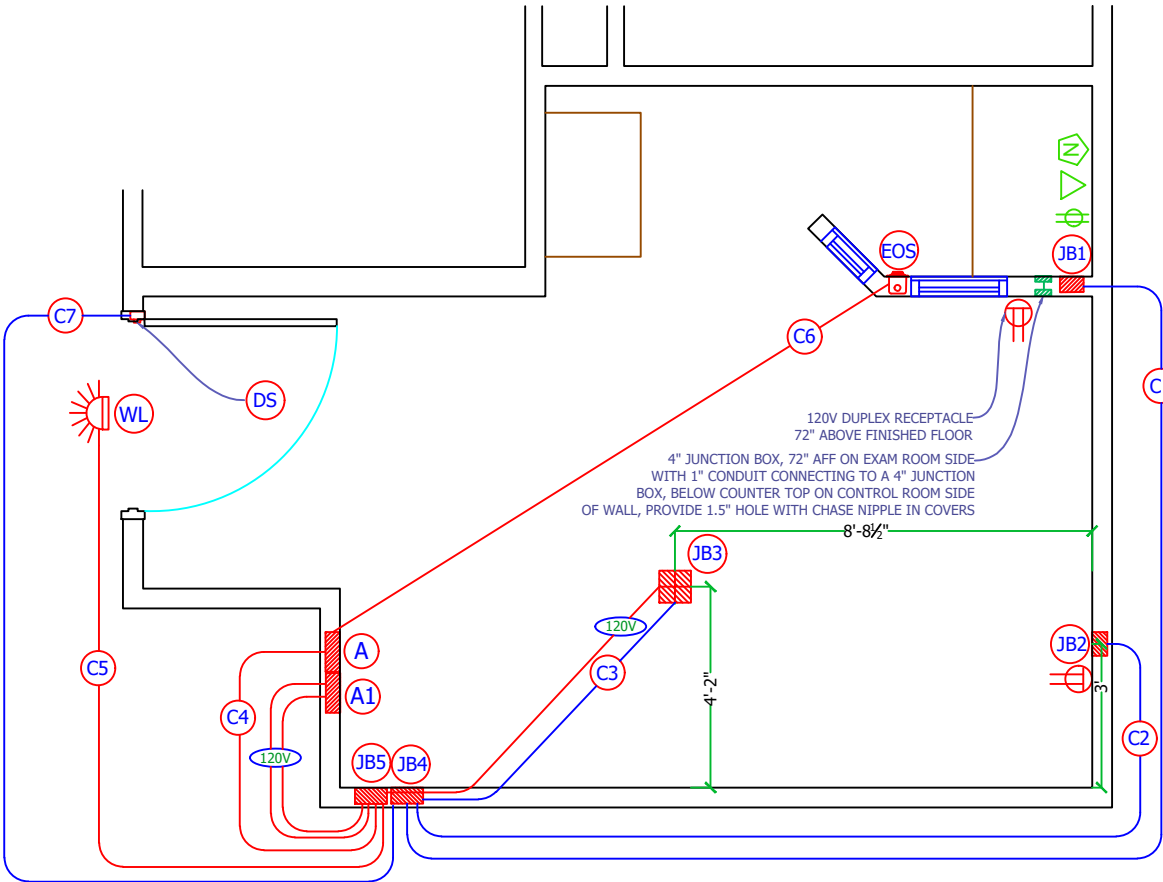
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CONDUIT REFERENCE:
RED LINES = HIGH VOLTAGE
BLUE LINES = LOW VOLTAGE



Provide the following for DR System, Located below Counter Top

- ⚡ 120 VAC, 20 Amp, Dedicated Quad Outlet
- 🌐 VPN Connection or Internet Access for Remote Diagnostics
- 📡 Provide (2) RJ-45 Network Connection w/Cat. 6 Cable Outlet

ELECTRICAL LEGEND	
FUTURE	
EXISTING	
INSTALLED BY CUSTOMER/CONTRACTOR	
FURNISHED BY CUSTOMER/CONTRACTOR	
INSTALLED BY TXC	
FURNISHED BY TXC	
ITEM	DESCRIPTION
A	BREAKER ENCLOSURE - 208-240VAC, SINGLE PHASE SHUNT TRIP TYPE BASED ON SPECS ON SHEET E2, PROVIDE EMERGENCY OFF SWITCH IN GENERAL AREA OF CONTROL ROOM AS SHOWN. PROVIDE 6' SEALTIGHT WITH 18" PIGTAIL ON GENERATOR SIDE. RUN FROM "JB5" TO REAR OF GEN. CABINET, USING (2) 90 DEGREE ELBOWS. SEE SHEET E3 FOR MORE INFO.
A1	(2) - 120VAC/20A BREAKERS/DISCONNECTS,(44" AFF) FOR SUPPLY TO DESIGNATIONS: "JB5" AND "JB3"-LEAVE 6FT PIGTAIL AT JB SIDE. ELECTRICIAN TO DETERMINED BEST METHOD OF RUN ACCORDING TO LOCAL CODES.
JB1	8" X 8" JUNCTION BOX 18" AFF, PROVIDE- 2" CHASE NIPPLE IN THE CENTER OF COVER.
JB2	6 X 6" JUNCTION BOX-48" AFF, FLUSH WITH WALL, PROVIDE- 2" CHASE NIPPLE IN THE CENTER OF COVER.
JB3	8" X 8" JUNCTION BOX FLUSH MOUNTED IN FLOOR WITH 2" CHASE NIPPLE ON COVER. IF UNABLE TO FLUSH MOUNT JB, THEN A WIRE RACEWAY WILL NEED TO BE USED AS SHOWN ON SHEET E4.
JB4	8" X 8" X 4" JUNCTION BOX, 18" AFF. PROVIDE A 3" X 8" GROMMETED OPENING IN THE COVER.
JB5	8" X 8" X 4" JUNCTION BOX, 18" AFF. PROVIDE A 3" X 8" GROMMETED OPENING IN THE COVER.
C1	2" CONDUIT FROM "JB1" TO "JB4".
C2	2" CONDUIT FROM "JB2" TO "JB4".
C3	2" CONDUIT IN OR UNDER FLOOR, RUN FROM BOTTOM OF "JB4" TO "JB3".
C4	CONDUIT RUN FROM "A" TO "JB4" SIZE OF CONDUIT TO BE DETERMINED BY WIRE SIZE AS SPECIFIED ON SHEET E2.
C5	CONDUIT SIZE DEPENDING ON WIRE SIZE AS NEEDED FOR 120V RUN FROM "WL" TO "JB5". EC TO PROVIDE THE POWER FOR THE LIGHT.
C6	"EOS" TO BE CONNECTED TO BREAKER "A".
C7	3/4" - CONDUIT RUN FROM "DS" TO "JB4". PROVIDE #16 AWG, 2 COND, FROM "DS" TO "JB4", LEAVE 6' PIGTAIL AT "JB4" SIDE.
DS	PROVIDE NORMALLY OPEN (MAGNETIC STYLE) DOOR SWITCH WITH WIRE RUN TO "JB4" - PROVIDED BY EC.
WL	X-RAY WARNING LIGHT, PULL 120VAC FROM LIGHT TO "JB5", LEAVE 8' PIGTAIL AT "JB4" SIDE. X-RAY GENERATOR WILL PROVIDE SWITCH.
EOS	EMERGENCY OFF SWITCH (SHUNT TRIP TYPE) TO BE CONNECTED TO THE "A" BREAKER AND SHOULD BE LOCATED NEAR CONTROL.

HVAC Environmental Notes:

Temperature must be regulated between 50 - 90 degrees F with relative humidity regulated at 30% to 85% non-condensing.

Heat output of equipment in one area must not affect temperature and humidity regulations in other areas. It is strongly recommended that each area be individually environmentally controlled with a thermostat.

Supply diffusers shall not cause direct air contact on patients or operators.

Typically, this system will operate in a normal office environment.

Sedecal SHF-510 50kw HF Generator Power Line Requirements

Line Voltage	Recommended Dist. Transfmr.	Wire Size - Distance from Distribution Transformer to Breaker Panel "A"			Breaker Size	Wire Size "A" to "JB5" Max. 20'	Max. Line Impedance
		50'	100'	150'			
208VAC	62.5kVa	#1	#3/0	N/A	125A	#4	0.028 ↷
230VAC	62.5kVa	#2	#2/0	#4/0	100A	#4	0.034 ↷
240VAC	62.5kVa	#2	#2/0	#4/0	100A	#4	0.037 ↷

Electrical Contractor to supply L1, L2 and Gnd in appropriate size conduit from "A" Breaker Panel to "JB5" leave 8' pigtail on "JB5" side.

Note: The above values comply with the Standard IEC-60601.2.7

For lines at 208V or below an auxiliary boost transformer is required to boost the line voltage to 240V.

Wire must be made of copper and flexible.

Grounding: Insulated grounding must conform with current requirements for electrically susceptible patient areas. See Article 517, National Electrical Code.

Maximum line regulation for maximum kVA demand:5%

NOTE: EC SHALL ENSURE THAT LUGS ARE LARGE ENOUGH TO FACILITATE OVERSIZED INCOMING CABLES REQUIRED BY X-RAY EQUIPMENT. REFER TO "INCOMING WIRE SIZE" NOTES.



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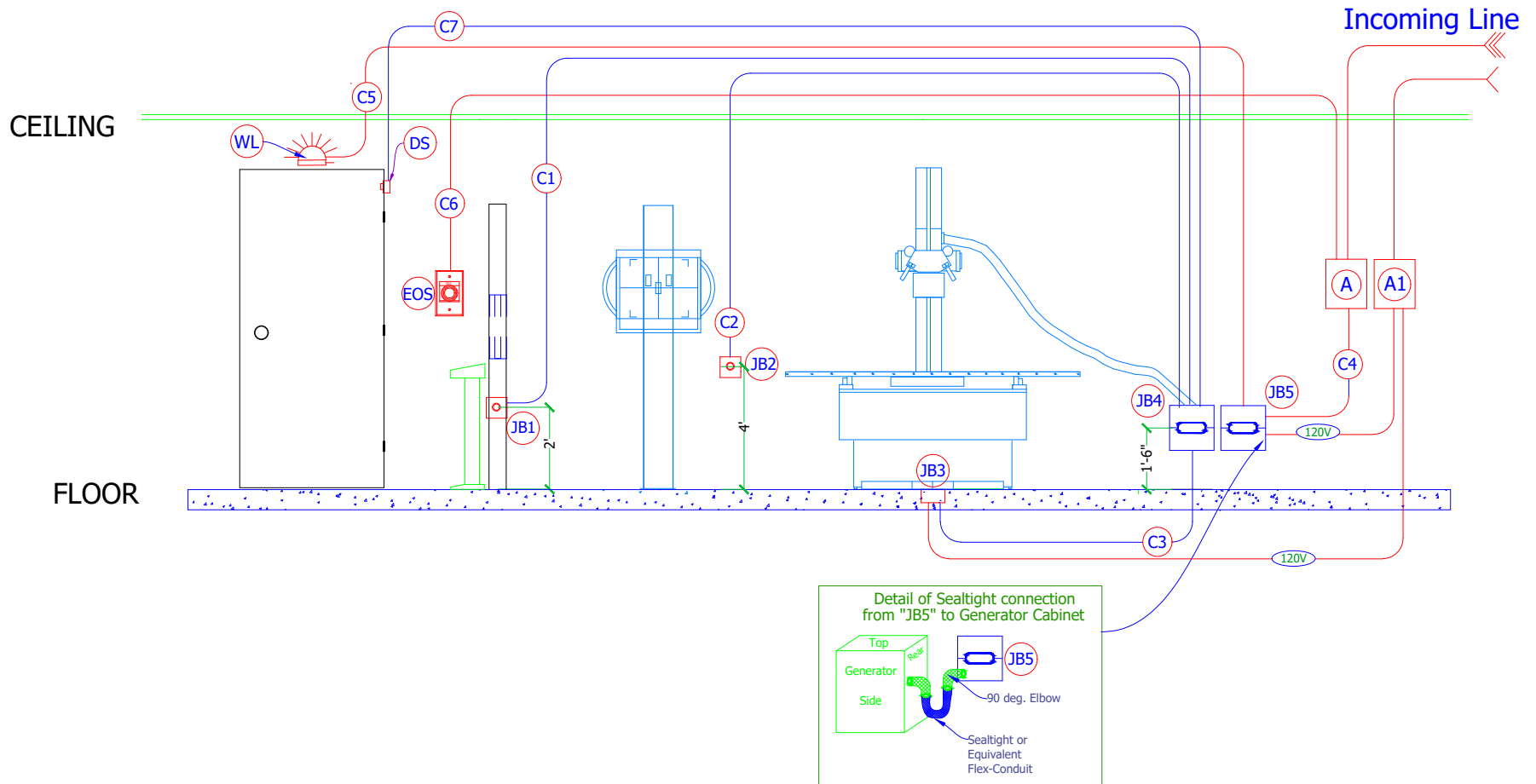
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Note: All conduit runs should be as short as possible due to cable length limitations.



Simplified Electrical Schematic

NOTE: REFER TO SHEET E1 FOR DETAILS



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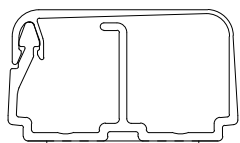
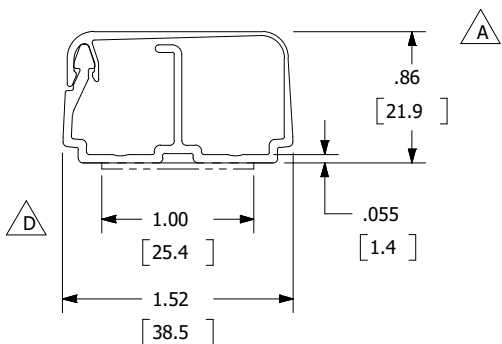
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Drawn by: Mike Kimbrough

As an alternative to flush mounting "JB3", EC to provide a surface mounted wire raceway similar to the below example. Also provide 2 90 deg. Elbows.

Detail of Suggested Wire Raceway -C3

THIS COPY IS PROVIDED ON A RESTRICTED BASIS AND IS NOT TO BE USED IN ANY WAY DETRIMENTAL TO THE INTERESTS OF PANDUIT CORP.



ADHESIVE BACK PRESSURE SENSITIVE FOAM TAPE .040 (1.0) THICK WITH PROTECTIVE LINER

PART NAME	PANDUIT PART NO. (** SEE NOTE 1)	LENGTH IN. (MM)	STATIC LOAD (SEE NOTE 2)	APPROXIMATE WEIGHT
DIVIDED CHANNEL POWER LATCHING DUCT	LD2P10**8-A	96.00 ± .18 (2438.4 ± 4.6)	.61 LB/IN (10.9 g/mm)	.159 LB/FT (.24 g/mm)
	LD2P10**10-A	120.00 ± .18 (3048.0 ± 4.6)		
	LD2P10**2-A	78.74 ± .18 (2000.0 ± 4.6)		

NOTES:

- SEE CURRENT CATALOG FOR ADDITIONAL PART NUMBER SUFFIXES TO INDICATE COLORS AND OR PACKAGE QUANTITY.
- PART IS DESIGNED TO SUPPORT MAXIMUM WEIGHT ON A CLEAN, DRY, SMOOTH SURFACE.
- TO APPLY PART:
 - REMOVE PROTECTIVE LINER.
 - PLACE PART IN DESIRED LOCATION.
 - APPLY PRESSURE TO FLAT SURFACE OF PART.
- DIMENSIONS IN PARENTHESIS ARE IN METRIC.
- ALLOWS THE ROUTING OF POWER AND COMMUNICATIONS CABLING IN A SMALL RACEWAY.
- NO WARRANTY, EXPRESSED OR IMPLIED, IS MADE BY PANDUIT WITH RESPECT TO ADHESIVE BOND PERFORMANCE. THE CONDITIONS UNDER WHICH THESE RACEWAYS MAY BE APPLIED AND/OR THE SURFACE TO WHICH THEY MAY BE APPLIED ARE BEYOND PANDUIT'S CONTROL.

REV	DATE	BY	CHK	DESCRIPTION	ECN	CHK	CUST	SUP
4	03-08-04	JHEP	RGRO	F. REMOVED PART NUMBER LD2P10**3-A	35541-65	RGRO	RGRO	
3	06-12-03	JBN	HIW	E. CAD FILE WAS D35541DM_TH_DW_LD10_02 D. REVISED TAPE WIDTH: WAS 1.25 [31.8]	35541-65	HIW	HIW	
2	05-21-99	RABO	HIW	C. ADDED 3M LENGTH	35541-65	HIW	HIW	
1	09-17-98	PM	HIW	B. REVISE NOTES A. REVISE CHART: REMOVE 72 IN. LENGTH	35541-65	HIW	HIW	
R	03-17-97	PM	CEF	RELEASED TO PRODUCTION	35541-65	CEF	CEF	

CAD FILENAME/LAYERS		E D35541DM_DC_LD2P10_03B.PRT (1)	
PANDUIT		CORP. TINLEY PARK, ILLINOIS	
DIVIDED CHANNEL POWER LATCHING DUCT (LD2P10) CUSTOMER DRAWING			
UNLESS OTHERWISE SPECIFIED, DIMENSIONAL TOLERANCES ARE: (.X) + .03 [.8] (.XXX) + .010 [.4] (.XX) + .03 [.8] ANGLES + .		UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE GIVEN IN INCHES, THIRD ANGLE PROJECTION.	
DRAWN BY: PM	MAT'L: RIGID PVC POLYVINYL CHLORIDE	SCALE: NONE	DWG NO: 35541-65
DATE: 03-17-97	CHECKED BY: CEF		SIZE: A



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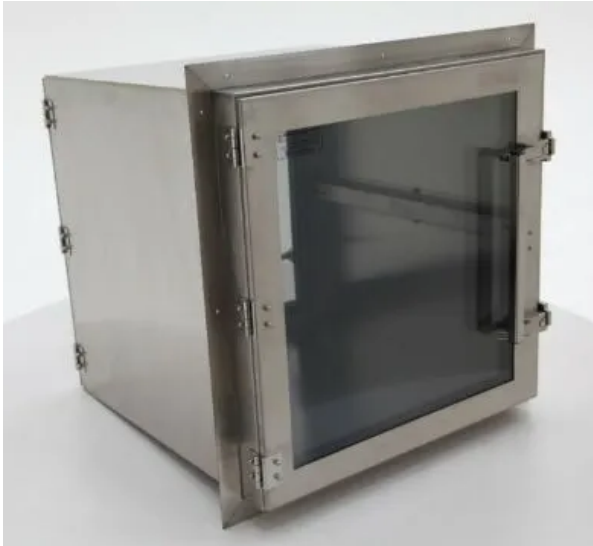
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Simplifies contamination-free transfer of materials between classified spaces | **2636-06D** displayed

- **Available ISO Ratings: ISO 6, ISO 7, ISO 8**
- Fully welded cleanroom passthrough without crevices, ideal for medical/pharmaceutical applications
- Continuous welds are suitable for moderate sterilization protocols
- Automatic door interlock allows only one door to open at a time to prevent cross-contamination
- Doors are leak-rated by UL for tight seal to maintain cleanroom air pressure gradients
- Stainless steel framed doors, latches, and hinges extend service life of passthrough chamber
- Inside Depth: 24"
- Inside Height: 24"
- Inside Width: 24"
- Concealed Interlock: No
- Continuous-Seam Welds: Yes
- Electropolished: Optional
- HEPA/ULPA Filtration: No
- Material: 304 Stainless Steel
- Model: CleanSeam™
- Mounting Position: Standard Wall
- Opening Dimensions: 22"W x 22"H
- Special Door Configuration: Leak-Rated
- Window Material: SD-PVC
- Unit of Measure: EA



Terra Part #: 2636-06D-2

Manufactured By: Terra Universal

Warranty: 1 year parts, 90 days labor

Print

Call a Terra CleanSeam™
Pass-Through Chambers
specialist direct:

714-459-0732

Mon - Fri, 10:00 AM - 09:00 PM
your local time

EMAIL CHAT

Summary

- • **Available ISO Ratings: ISO 6, ISO 7, ISO 8**
- Fully welded cleanroom passthrough without crevices, ideal for medical/pharmaceutical applications
- Continuous welds are suitable for moderate sterilization protocols
- Automatic door interlock allows only one door to open at a time to prevent cross-contamination
- Doors are leak-rated by UL for tight seal to maintain cleanroom air pressure gradients
- Stainless steel framed doors, latches, and hinges extend service life of passthrough chamber
- Cleanroom pass throughs reduce foot traffic, improve cleanliness, safety, productivity, and much more.
- **Chamber Design:**
- **Corrosion resistant all-304 stainless steel surfaces** resists most harsh chemicals and alcohol-based cleaning agents, won't produce contaminants during sterilization.
- **Seamless welds** eliminate hard-to-clean cracks and crevices where contaminants can collect.
- **Door Design:**
- Access doors with 304 stainless steel reinforced frames extend passthrough chamber's service life and provide a tight seal.
- **Santoprene® "e"-shape non-outgassing rubber gasket** firmly compresses to eliminate leaks. The one-piece resilient rubber gasket maintains its shape after compression and won't flatten, warp, crack, or degrade like ordinary foam gasket. Gasket is also mechanically attached to the door frame to avoid adhesive failure common with gasket tapes.
- Heavy-duty stainless steel lift latches included to minimize scratching, corrosion and contamination resulting over time that can occur with chrome-plated latches.
- Chemical-resistant, static-dissipative PVC windows prevent static-clinging of particulates.
- Order replacement door(s) to avoid critical operation delays should a door be damaged and require immediate replacement.
- **Includes:**
- (1) Automatic mechanical interlock
- Mounting brackets; Standard bracket mounting is 2" (51mm) from the front on the cleanroom side - specify other desired location
- Optional upgrade: to prevent users on both sides from forcefully pulling the doors open at the same time and risking damage, Smart CleanMount Pass-Throughs offer visual red/green status lights to notify users when a door can be opened safely.

Specifications






- **Inside Depth:** 24"
- **Inside Height:** 24"
- **Inside Width:** 24"
- **Concealed Interlock:** No
- **Continuous-Seam Welds:** Yes
- **Electropolished:** Optional
- **HEPA/ULPA Filtration:** No
- **Material:** 304 Stainless Steel
- **Model:** CleanSeam™

- **Mounting Position:** Standard Wall
- **Opening Dimensions:** 22"W x 22"H
- **Special Door Configuration:** Leak-Rated
- **Window Material:** SD-PVC
- **Unit of Measure:** EA

Helena

- **Dimensions, Product:** 27" W x 28" D x 27" H
- **Dimensions, Shipping:** 29.75" W x 33.5" D x 36.5" H
- **Marks & Listings:** CE, UL, ULC
- **Package Type:** Crate
- **Weight, Product:** 91 lb
- **Weight, Shipping:** 206 lb

CleanSeam™ Pass-Through Chambers

 <p>Cleanroom Pass-Through Features and Selection Guide</p>	
 <p>CleanSeam™ Pass-Through Chambers</p>	
 <p>Double Stacked Stainless Steel CleanSeam Pass-Through Chambers</p>	
 <p>Stainless Steel Hospital Pass-Through for Primary, Secondary, Tertiary Services</p>	

Video introduction to pass-through chamber designs, construction and accessories | [1948-20D](#) displayed

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SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single and double rollers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 3 inches square. Mark interior face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

D. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS (**SHD-2**)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hunter Douglas Contract.
 - 2. MechoShade Systems, Inc. (Basis-of-Design)
 - 3. Springs Window Fashions; SWF Contract.
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Manufacturer's standard.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.

-
2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

 - C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 1. Roller Drive-End Location: Right side of interior face of shade.
 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

 - D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

 - E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

 - F. Shadebands:
 1. Shadeband Material: Light-filtering fabric: 3 percent open shade cloth.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Exposed with endcaps and integral light seal at bottom where it meets the sill.
 - b. Color and Finish: As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.

 - G. Installation Accessories:
 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.
 2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than height indicated on Drawings.
 3. Endcap Covers: To cover exposed endcaps.
 4. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.

- a. Closure-Panel Width: As indicated on Drawings.
5. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 MANUALLY OPERATED BOTTOM-UP SHADES (**SHD-1**)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hunter Douglas Contract.
 2. MechoShade Systems, Inc. (Basis-of-Design)
 3. Springs Window Fashions; SWF Contract.
- B. Configuration:
 1. Bottom-Up Single Roller
- C. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 1. Bead Chains: Manufacturer's standard.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.
 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.
- D. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 1. Roller Drive-End Location: Right side of interior face of shade.
 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- F. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- G. Shadebands:
 1. Shadeband Material: Light-filtering fabric: 1 percent open shade cloth.

2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

H. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.
2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than height indicated on Drawings.
3. Endcap Covers: To cover exposed endcaps.
4. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
 - a. Closure-Panel Width: As indicated on Drawings.
5. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 1. Source: Mermet.
 2. Type: PVC-coated polyester.
 3. Weave: Basketweave.
 4. Weight: 16.4 oz./sq. yd..
 5. Orientation on Shadeband: Up the bolt.
 6. Openness Factor: 3 percent.
 7. Color: As indicated on Finish Legend on Drawings.
- C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.
 1. Source: Mermet.
 2. Type: PVC-coated fiberglass with bonded PVC film.
 3. Orientation on Shadeband: Up the bolt .
 4. Color: As selected by Architect from manufacturer's full range.

2.5 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
 - 2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 - 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

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SECTION 123216 - MANUFACTURED PLASTIC-LAMINATE-FACED CASEWORK**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Plastic-laminate-faced cabinets of stock design.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking for anchoring casework.
2. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring casework.
3. Section 096513 "Resilient Base and Accessories" for resilient base applied to plastic-laminate-faced casework.
4. Section 123570 "Healthcare Casework."

1.2 DEFINITIONS

- A. Definitions in the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" apply to the work of this Section.
- B. MDF: Medium-density fiberboard.
- C. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

1.5 ACTION SUBMITTALS

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

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.
- C. Samples: 8-by-10-inch Samples for each type of finish.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- C. Sample Warranty: For special warranty.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 10 years documented experience.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project with a minimum of two year's experience in the installation of the manufacturer's casework.
- C. Seismic Performance: Laboratory casework and support framing system, including attachments to other work, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

- C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Failure of operating hardware.
 2. Warranty Period: Lifetime except as three years for items noted below:
 - a. Task Lighting.
 - b. Casters.
 - c. Bag Racks.
 - d. Carts.
 - e. Adjustable keyboards.
 - f. Modular Shelf Standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AMCASE Modular Casework (Local Representative: CBI Workplace Solutions, Rachel Lawver (919)695-4330.
- B. Source Limitations: Obtain plastic-laminate-faced cabinets from single manufacturer.
- C. Product Designations: Drawings indicate sizes and configurations of plastic laminate casework by referencing designated basis-of-design manufacturer's components. Sizes are critical and other manufacturer's laboratory casework, if proposed as substitute, must fit through doors, provide clearances, and conform to plans.

2.2 CASEWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.
1. Grade: Custom.

2.3 CASEWORK

- A. Design: Flush overlay.
- B. Exposed Materials:
 - 1. Plastic Laminate: Grade HGS.
 - 2. Unless otherwise indicated, provide specified edgebanding on all exposed edges.
- C. Semi-exposed Materials:
 - 1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semi-exposed surfaces unless otherwise indicated.
 - a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
 - 2. Thermoset Decorative Panels: Provide thermoset decorative panels for semi-exposed surfaces unless otherwise indicated.
 - a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
 - 3. Metal for Steel Drawer Pans: Cold-rolled, carbon-steel sheet complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.
 - 4. Unless otherwise indicated, provide specified edgebanding on all semi-exposed edges.
- D. Concealed Materials:
 - 1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
 - 2. Plywood: Hardwood plywood.
 - 3. Plastic Laminate: Grade BKL.
 - 4. Particleboard.
 - 5. MDF.

2.4 MATERIALS

- A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.
- C. Softwood Plywood: DOC PS 1.
- D. Particleboard: ANSI A208.1, Grade M-2.
- E. MDF: ANSI A208.2, Grade 130.
- F. Plastic Laminate (**PLM-1**): High-pressure decorative laminate complying with NEMA LD 3.

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Formica Corporation.
 - b. Nevamar; a Panolam Industries International, Inc. brand.
 - c. Pionite; a Panolam Industries International, Inc. brand.
 - d. Wilsonart (Basis-of-Design).
 - G. Edgbanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 2 mm thick.
 - H. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
 - I. Edgbanding for Thermoset Decorative Panels: PVC or polyester edgbanding matching thermoset decorative panels.
- 2.5 COUNTERTOPS
- A. Countertops, General: Provide units with smooth surfaces in uniform plane, free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch, with continuous drip groove on underside 1/2 inch from edge.
 - B. Solid-Surfacing Countertops: As specified in Section 123661.16 Solid Surfacing Countertops” and as indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.
- 2.6 COLORS AND FINISHES
- A. Thermoset Decorative Panel Colors, Patterns, and Finishes: As selected by Architect.
 - B. Plastic-Laminate Colors, Patterns, and Finishes:
 1. As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.
 - C. PVC Edgbanding Color: As selected by Architect from casework manufacturer's full range.
- 2.7 SUSPENSION SYSTEM
- A. Provide suspensions system of rails and brackets to ensure wall cabinets can be moved and re-installed.
 - B. Rail: Galvanized steel with slotted holes for screw attachment to wall.
 1. Loading Capacity: 330 pounds per cabinet.
 - C. Bracket: Galvanized steel with white plastic cover, designed for mounting within case; brackets exposed on side of case are not acceptable.

1. Loading Capacity: 140 pounds per bracket.
2. Adjustability: +/- 7 mm for height; 15 mm for depth; +/- 7 mm laterally.
3. Closed form to prevent cabinet from sliding off rail.

2.8 FABRICATION

- A. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:
1. Joinery: Provide Hafele mini-fix cam hidden fastener system, predrilled, with metal to metal contact or other joinery system compliant with referenced standard.
 2. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard.
 3. Shelves: 3/4-inch-thick plywood or 1-inch-thick particleboard, lipped edge to retain product on sloped shelves.
 4. Backs of Cabinets: 1/2-inch-thick particleboard or MDF where exposed, 1/4-inch hardboard dadoed into sides, bottoms, and tops where not exposed.
 5. Drawer Fronts: 3/4-inch particleboard.
 6. Drawer Bodies: Steel drawer pans formed from 0.0359-inch-thick metal, metallic phosphate treated, and finished with manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat with a minimum dry film thickness of 1 mil for topcoat and 2 mils for system.
 - a. Drawer Insert: One-piece seamless insert with custom dividers.
 7. Doors 3/4 inch thick, with particleboard or MDF cores.
- B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.9 CASEWORK HARDWARE AND ACCESSORIES

- A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.
1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, Type B01602, 110 degrees of opening, self-closing. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.
- C. Pulls: Solid aluminum or stainless-steel wire pulls, fastened from back with two screws.
- D. Drawer Slides: BHMA A156.9, Type B05091.
1. Heavy Duty (Grade 1HD-100): Side mounted; full-extension type; zinc-plated, steel ball-bearing slides with soft close.

- E. Adjustable Shelf Supports: Two-pin locking plastic shelf rests complying with BHMA A156.9, Type B04013.
- F. Leveling system: 330-pound load capacity with socket head adjustment from inside base cabinet.
- G. Cantilevered Brackets: Adjustable.
- H. Casters.

2.10 ACCESSORIES

- A. Undercabinet Task-Light Fixtures: Single-tube fluorescent fixtures with switch and heavy-duty cord and plug.
 - 1. Finish: Baked enamel.
 - 2. Diffusers: Virgin acrylic with high resistance to yellowing and other changes due to aging, heat, and UV radiation.
 - 3. Ballast Sound Rating: A.
- B. Flexible drawer dividers.
- C. Aluminum Wall Base (**AB-1**):
 - 1. Basis-of-Design Product: Schulter-DESIGNBASE – SL
 - a. Description: Anodized Aluminum Baseboard profile comprised of a symmetrically rounded top, flat exposed face, and 5/16 inch (8 mm) radius lower section.
 - b. Corners:
 - 1) Provide with matching inside corners.
 - 2) Provide with matching outside corners.
 - 3) Provide with matching connectors.
 - 4) Provide with matching end caps.
 - 5) Provide with matching Sealing Lip.
 - c. Material and Finish: AE - Satin Anodized Aluminum.
 - d. Height: 3-1/8 inch (80 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CASEWORK INSTALLATION

- A. Install casework level, plumb, and true; shim as required, using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
- D. Fasten cabinets to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWT's, AWMAC's, and WT's "Architectural Woodwork Standards."
- E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- F. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 CLEANING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 123216

SECTION 123570 - HEALTHCARE CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless-steel medical casework and documentation station.
2. Stainless-steel countertops.
3. Solid phenolic compact countertops.
4. Stainless-steel shelving.

1.2 SUBMITTALS

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

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

1. Indicate locations of blocking and reinforcements required for installing casework.
2. Indicate hardware locations.
3. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and equipment.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain healthcare casework through one source from a single manufacturer.

B. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.5 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for support of healthcare casework.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Getinge USA.
 2. InnerSpace; a Solaire Medical company.
 3. MAC Medical, Inc.
 4. Southwest Solutions Group.

2.2 CASEWORK MATERIALS

- A. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, stretcher-leveled standard of flatness.
- B. Nominal Stainless-Steel Thicknesses for Stainless-Steel Medical Casework:
1. Sides, Ends, Fixed Backs, Bottoms, Cabinet Tops, Soffits, and Items Not Otherwise Indicated: 0.050 inch. Bottoms may be 0.038 inch if reinforced.
 2. Back Panels, Doors, Drawer Fronts and Bodies, and Shelves: 0.038 inch except 0.050 inch for unreinforced shelves more than 36 inches long.
 3. Intermediate Horizontal Rails, Center Posts, Tubular Legs, and Top Gussets: 0.062 inch.
 4. Drawer Runners and Hinge Reinforcements: 0.078 inch.
 5. Leveling and Corner Gussets: 0.109 inch.
- C. Glass for Glazed Doors: Clear tempered glass complying with ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than 5.0 mm thick.

2.3 CABINET FABRICATION

- A. General: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Integrally frame and weld to form a dirt and vermin-resistant enclosure. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch.
1. Manufacturer's typical unit height may vary by no more than 6 inches to match overall height indicated on Drawings.
 2. Provide built-in storage cabinets and desk consoles in configuration indicated. Provide base for units.
 - a. Contractor to provide gypsum board soffit above units.
- B. Glazed Doors: Hollow-metal stiles and rails of similar construction as flush doors, with glass held in resilient channels or gasket material.
- C. Hinged Doors: Mortise for hinges and reinforce with angles welded inside inner pans or hollow metal stiles at hinge edge.

- D. Metal Drawers: Fronts made from outer and inner pans that nest into box formation, with no raw metal edges at top. Sides, back, and bottom fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal.
- E. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets and with hemmed or flanged edges.
- F. Trim Flanges: Formed metal trim fabricated from same material and with same finish as cabinets. Provide at perimeter of recessed cabinets.

2.4 STAINLESS-STEEL FINISH

- A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece.
- B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

2.5 CABINET HARDWARE

- A. General: Provide healthcare casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Hinges: Stainless-steel 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and hospital tips. Provide 2 for doors 48 inches high or less and 3 for doors more than 48 inches high.
- C. Hinged Door and Drawer Pulls: Stainless-steel back-mounted pulls.
 - 1. Design: Wire pulls.
 - 2. Overall Size: 1 by 4-1/2 inches.
- D. Door Catches: Manufacturer's standard roller type or magnetic type. Provide 2 catches on doors more than 48 inches high.
- E. Drawer Slides: Side-mounted, epoxy-coated steel, self-closing, ball-bearing drawer slides; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.
 - 1. Provide Grade 1HD-100 for drawers not more than 6 inches high and 24 inches wide.
 - 2. Provide Grade 1HD-200 for drawers more than 6 inches high or 24 inches wide.
 - 3. Provide Grade 1HD-100 for computer keyboard shelves.
 - 4. Heavy Duty (Grade 1HD-100 or Grade 1HD-200): Full-extension type.
- F. Locks: Cam or half-mortise type; brass with chrome-plated finish; complying with BHMA A156.11, Type E07281, E07111, or E07021.
 - 1. Provide minimum of two keys per lock and two master keys.

2. Provide locks for each tall cabinet and each drawer.
3. Keying: Key locks within each room alike, key each room separately.
4. Master Key System: Key all locks to be operable by master key.

2.6 STAINLESS-STEEL COUNTERTOPS AND SHELVES

- A. Countertops: Provide units with smooth surfaces in uniform plane free of defects. Ease exposed edges and corners. Provide front and end overhang of 1 inch over base cabinets.
1. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, not less than 0.062-inch nominal thickness, with No. 4 directional satin finish.
 2. Extend top down 1 inch at edges with a 1/2-inch return flange under frame. Apply heavy coating of heat-resistant, sound-deadening mastic to undersurface.
 3. Form backsplash coved to and integral with top surface.
 4. Provide rolled edge unless otherwise indicated.
 5. Reinforce underside of countertop with channels or use thicker metal sheet where necessary to insure rigidity without deflection.
 6. Weld shop-made joints.
 7. Fabricate units for installation without field-made joints.
 8. After fabricating and welding, grind surfaces smooth and polish as needed to produce uniform, directionally textured finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
- B. Wall-Mounted Shelves: Made from stainless-steel sheet, ASTM A240/A240M, Type 304, not less than 0.050-inch nominal thickness, with No. 4 directional satin finish. Weld shop-made joints. Fold down front edge 3/4 inch; fold up back edge 3 inches. Provide integral stiffening brackets, formed by folding up ends 3/4 inch and welding to upturned back edge. After fabricating, grind welds smooth and polish as needed to produce uniform, directionally textured finish with no evidence of welds and free of cross scratches. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.

2.7 SOLID PHENOLIC COMPACT (SPC) COUNTERTOPS

- A. Solid Phenolic Compact (**SPC-1**) Material: Chemical-resistant, self-supporting flat panel based on thermosetting resins, homogeneously reinforced with cellulose fibers and manufactured under high-pressure.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - a. Durcon SPC by Durcon, Inc.
 2. Chemical Resistance: Minimum acceptable chemical-resistance performance to result in no more than four (4) Level 3 conditions when tested with indicated reagents in accordance with SEFA 3.
 3. Color: As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.

- B. Fabricate with cutouts for sinks, holes for service fittings and accessories, and butt joints assembled with epoxy adhesive and concealed metal splines.
 - 1. Flat Configuration: 1 inch thick with continuous drip groove on underside 1/2 inch from overhang edge with integral coved backsplash.
 - a. Edges and Corners: Rounded.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of healthcare casework.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CABINETS AND SHELVES

- A. Install level, plumb, and true; shim as required, using concealed shims. Where healthcare 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.
 - 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
 - 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
 - 4. Variation of Adjacent Cabinet Surfaces from a True Plane (Lippage): 1/32 inch.
 - 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- B. Recessed Cabinets: Set cabinets in openings and fasten to partition framing, wood blocking, or reinforcements in partitions with fasteners spaced 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- C. Base Cabinets: Fasten cabinets to partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- D. 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 24 inches o.c.
- E. Wall-Mounted Shelves: Fasten to masonry, partition framing, blocking, or reinforcements in partitions. Fasten each shelf through upturned back edge at not less than 24 inches o.c.
- F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

- G. Adjust healthcare 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.

3.3 INSTALLATION OF COUNTERTOPS

- A. Abut top and edge surfaces in one true plane with flush joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.
- B. Fastening: Secure countertops to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
- C. Provide chemical-resistant, permanently elastic sealing compound for closures at junctures of top, curb, and splash with walls as recommended by sealant manufacturer.

3.4 CLEANING AND PROTECTING

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish as approved by Architect.
- B. Protect countertop surfaces during construction with 6-mil-thick polyethylene or other suitable water-resistant covering. Tape to underside of countertop at minimum of 48 inches o.c.

END OF SECTION 123570

SECTION 123653 - LABORATORY WORKSURFACES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Epoxy resin worksurfaces.
2. Setting materials.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for steel supports.
2. Section 061053 "Miscellaneous Rough Carpentry" for wood supports.
3. Section 079200 "Joint Sealants" for joint sealers.
4. Section 092900 "Gypsum Board" for cementitious backer unit substrate.
5. Section 123216 "Manufactured Plastic-Laminate-Faced Casework."
6. Section 123570 "Healthcare Casework."
7. Section 224000 "Plumbing Fixtures" for plumbing fixtures and trim.

1.2 REFERENCES

A. ASTM International (ASTM):

1. D570 - Standard Test Method for Water Absorption of Plastics.
2. D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
3. D648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Oad in edgewise Position.
4. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
5. D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -300 C and 300 C With a Vitreous Silica Dilatometer.
6. D785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
7. D790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
8. D792 - Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
9. D3801 - Standard Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical Position.
10. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. International Organization for Standardization (ISO) 9001 - Quality Management Systems - Requirements.

- C. NSF International / American National Standards Institute (NSF/ANSI) - 51 - Food Equipment Materials.
- D. Scientific Certification Systems (SCS) - Recycled Content Certifications.
- E. Scientific Equipment and Furniture Association (SEFA) 3 - Work Surfaces.

1.3 SUBMITTALS

A. Submittals for Review:

1. Shop Drawings:

- a. Submit plan, section, elevation and perspective drawings necessary to describe and convey layout, profiles, and product components, including edge conditions, joints, fitting and fixture locations, anchorage, accessories, and finish colors.
- b. Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on Shop Drawings.
- c. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

2. Product Data: Manufacturer's data sheets on each product to be used, including:

- a. Preparation instructions and recommendations.
- b. Storage and handling requirements and recommendations. c. Installation methods.

3. Samples:

- a. Selection samples: For each finish product specified, submit complete set of color chips representing manufacturer's full range of standard colors.
- b. Verification samples: For each finish product specified, submit samples representing actual product color; supplied product color and gloss may vary slightly from supplied samples.

B. Quality Control Submittals:

- 1. Test Reports: Certified test reports or recognized evaluation reports showing compliance with specified performance characteristics and physical properties.

C. Closeout Submittals:

1. Maintenance Data:

- a. Provide maintenance, cleaning, and life cycle information.
- b. Include recommended cleaning materials and procedures, and list of materials detrimental to epoxy resin.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Primary products furnished by single manufacturer with minimum 10 years documented experience in work of this Section.
 2. Products manufactured in ISO 9001 certified facility.
- B. Installer Qualifications: Minimum 5 years documented experience in work of this Section.
- C. Mockup:
1. Construct worksurface mockup, 6 feet wide x full depth.
 2. Include worksurface, and trim.
 3. Locate where directed.
 4. Approved mockup may remain as part of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
1. Use pallets larger than sheets during transportation.
 2. Package materials to prevent damage during shipping and handling.
- B. Storage:
1. Store products in enclosed area protected from ultraviolet.
 2. Store products in manufacturer's unopened packaging until ready for installation.
 3. Store panels using protective dividers to avoid damage to surfaces.
 4. For horizontal storage, store sheets on pallets of equal or greater size than sheets with protective layer between pallet and sheet and on top of uppermost sheet.
 5. Do not store sheets or fabricated panels vertically.
- C. Handling:
1. If protective film is provided, do not remove until panel has been installed.
 2. Handle sheets to prevent damage.
 3. Remove stickers immediately after installation.

1.6 PROJECT CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's limits.
- B. Avoid direct exposure of products to sunlight.
- C. Do not use worksurfaces as bench, ladder, or seating.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Contract Documents are based on products by Durcon, Incorporated, 206 Allison Drive, Taylor, TX 76574, 512-595-8000, www.durcon.com.
- B. Substitutions: Under provisions of Section 012500 "Substitution Procedures."

2.2 MATERIALS**A. Solid Epoxy Resin (SPC-1):**

- 1. 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.
- 2. Sheets cast from modified epoxy resin and non-asbestos inert fillers with 10 percent of filler certified as post-consumer glass by SCS; compounded mixture cured and thermoset specifically from formulation to provide exceptional physical and chemical resistance required in medium to heavy duty laboratory environments.
- 3. Sheets monolithic throughout without surface coating application.
- 4. Certified to NSF/ANSI 51.
- 5. 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 8.
- 6. Color: As indicated in the Arch – Material Finishes (Interior) legend on the Drawings

2.3 ACCESSORIES

- A. Installation Materials: Manufacturer's joint adhesive, panel adhesive, and sealants as required to suit project conditions.

2.4 FABRICATION

- A. Fabricated tops and accessories in accordance with manufacturer's recommendations, approved Shop Drawings, and SEFA 8.

- B. Epoxy Resin Worksurfaces:

1. Thickness:

- a. 1 inch (25 mm) unless otherwise indicated.
- b. Check each sheet at factory for required thickness.
- c. Maximum variation in thickness: plus or minus 1/16 inch (1.6 mm) from corner to corner.

2. Warpage:

- a. Inspect tops for warpage prior to fabrication by placing on true flat surface.
- b. Maximum allowable warpage: 1/16-inch (1.5 mm) in 36-inch (900 mm) span or 3/16 inch (4.5 mm) in 96 inch (2400 mm) span.

3. Fabrication:

- a. Shop fabricate in longest practical lengths.
- b. Bond joints with highly chemical resistant cement with properties and color similar to base material.
- c. Provide 1/8-inch (3 mm) drip groove at underside of exposed edges, set back 1/2 inch (13 mm) from face.
- d. Finish exposed edges.

4. Fabricate tops flat [Flat with 1/4 inch (6 mm) raised marine edge at epoxy sink locations.

5. Edge treatment: Standard 1/8 inch (2 mm) chamfered edge.

6. Corner treatment: exposed corners shall be eased slightly for safety.

7. Back and end splashes:

- a. Supplied loose for field installation.
- b. Same material and thickness as worksurfaces.
- c. 4 inches (100 mm) high unless otherwise indicated.
- d. Top-mounted end splash where worksurfaces abut adjacent construction at and locations indicated on Drawings.

8. Joints: Maximum 1/8 inch (2 mm), bonded with epoxy grout.

9. Make joints between two benches level.

10. Locate joints away from sinks and over or near supports.

11. Sink cutouts: As indicated on Drawings.

12. Allowable tolerances:

- a. Square: Plus or minus 1/64 inch (0.4 mm) for each 12 inches (300 mm) of length.
 - b. Location of cutouts and drilled openings: Plus or minus 1/8 inch (3 mm) of design dimension.
 - c. Size of cutouts and drilled openings: Plus 1/8 inch (3 mm) or minus 0 inches (0 mm).
- C. 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 EXAMINATION

- A. Do not begin installation until cabinets have been installed.
- B. Confirm that surfaces to receive tops are plumb and level, with maximum deflection of 1/4 inch (6 mm) in 20 feet (6 m).

3.2 PREPARATION

- A. Clean surfaces just prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved Shop Drawings.
- B. Install tops plumb and level.
- C. Scribe to adjacent surfaces in accordance with manufacturer's recommendations.
- D. Fasten tops to supporting construction with adhesives appropriate for use with adjoining construction and as recommended by manufacturer.
- E. Form field joints using manufacturer's recommended adhesive. Form joints to be inconspicuous and nonporous.
- F. Install using fasteners and adhesive appropriate for use with adjoining construction and as recommended by manufacturer.

3.4 PROTECTION

- A. Protect installed products until completion of Project.
- B. Touch up, repair, or replace damaged products.

END OF SECTION 123653

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SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size solid surface material countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

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

B. Installer Qualifications: Fabricator of countertops.

- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
1. Build mockup of typical countertop as shown on Drawings.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS (SSM-1), (SSM-2), (SSM-3)

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
1. Basis-of-Design Products: Subject to compliance with requirements, provide products by the following:
 - a. Wilsonart International.
 2. Type: Provide Standard type unless Special Purpose type is indicated.
 3. Colors and Patterns: As indicated in the Arch – Material Finishes (Interior) Legend on the Drawings.
- B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
1. Grade: Custom.
- B. Configuration:
1. Front: Straight, slightly eased at top.
 2. Backsplash: Straight, slightly eased at corner.
- C. Countertops: 3/4-inch- thick, solid surface material.
- D. Backsplashes: 3/4-inch- thick, solid surface material.

- E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- F. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated.
- G. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - b. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.
 - c. Provide 3/4-inch full bullnose edges projecting 3/8 inch into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

-
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
 - D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
 - G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
 - H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 124813 - ENTRANCE WALK-OFF CARPET

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient-tile entrance mats.

1.2 COORDINATION

- A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.3 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 floor mats.

B. Shop Drawings:

1. Items penetrating floor mats, including door control devices.
2. Divisions between mat sections.
3. Perimeter floor moldings.

C. Samples: Floor mat, in manufacturer's standard sizes.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For floor mats to include in maintenance manuals.

1.5 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. Resilient-Tile Entrance Mats: Full-size tile units equal to 2 percent of amount installed, but no fewer than 10 units.

PART 2 - PRODUCTS**2.1 ENTRANCE FLOOR MATS, GENERAL**

- A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities.

2.2 RESILIENT-TILE ENTRANCE MATS

- A. Polyester carpet bonded to flexible vinyl backing to form mats of manufacturer's standard thickness with nonraveling edges. Provide sizes, colors, textures and patterns as indicated.
- B. Subject to compliance with requirements provide product indicated in the Arch – Material Finishes (Interior) Legend on the Drawings or an Architect approved comparable product by one of the following:
 - 1. Patcraft.
 - 2. Milliken
 - 3. Mohawk
 - 4. Shaw
 - 5. Tandus

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.
- B. Install units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.

3.3 PROTECTION

- A. Protect mats until construction traffic has ended and Project is at Substantial Completion.

END OF SECTION 124813

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SECTION 132113.13 - CLEAN ROOM PASS-THROUGH CHAMBERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. CleanSeam Pass-Through Chambers.

B. Related Requirements:

1. Section 055000 "Metal Fabrications."
2. Section 079200 "Joint Protection."
3. Section 087100 "Door Hardware."

1.2 REFERENCES

A. ASTM International

1. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.
2. ASTM A666 - Standard Specification for Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

B. ANSI/UL 10B - Standard for Fire Tests of Door Assemblies.

C. CAN/ULC-S104-10 - Standard Method for Fire Tests of Door Assemblies

D. FS 209E - Cleanroom and Workstation Requirements, Controlled Environments.

E. ISO 146744-1 - Cleanrooms and associated controlled environments Part 1: Classification of air cleanliness.

F. UL (Underwriters Laboratories, Inc.) - Electrical Appliance and Utilization Equipment Directory.

G. FDA/cGMP Requirements - 21 CFR Section 211 and Proposed Guidelines 21 CFR Section 212.

1.3 DESIGN/PERFORMANCE REQUIREMENTS

- A. Cleanroom Pass Through shall be capable of maintaining the following cleanroom performance requirements when installed as follows.

1. Capable of maintaining Class 100 to 10,000 (ISO 5 to ISO 8) conditions in accordance with FS 209E and ISO 146744-1.
 2. Capable of meeting validation requirements of FDA/cGMP and the following requirements.
 - a. Nonviability Particle Count: Maximum of 10,000 per cf, 0.5 micron or larger measured 6 inches above work surface (Class 10,000/ISO 7). Other permissible counts accord with nominal cleanliness rating (1000 per cf. for ISO 6, 100 per cf. for ISO 5).
 - b. Viable Count: Less than 1.5 colony forming units per 10 cubic feet. Other permissible counts in accord with nominal cleanliness rating.
 3. Capable of maintaining a passive pressure differential of:
 - a. Area outside room: balance condition
 - b. Air lock: 0.05-inch w.g.
 - c. Cleanroom: 0.1-inch w.g.
- B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013300 "Submittal Procedures."
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and finish.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment and periodic cleaning and maintenance of all components.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of products specified in this section with minimum 10 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of this section with minimum 5 years documented experience.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Locate where designated by Architect.
 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 3. Refinish mock-up area as required to produce acceptable work.
- D. Preinstallation Meetings: Conduct meeting to verify project requirements, substrate conditions, utility connections, manufacturer's installation instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Do not deliver materials or assemblies to site until installation spaces are ready to receive units.

1.7 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Terra Universal, Inc., which is located at: 800 S. Raymond Ave.; Fullerton, CA 92381-5234; Tel: 714-578-6000; Fax: 714-578-6020; Email: request info (info@TerraUniversal.com); Web: <https://www.terrauniversal.com>.
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 012500 "Substitution Procedures."

2.2 CLEANSEAM PASS-THROUGH CHAMBERS

- A. CleanSeam 304 Stainless Steel Pass-Through Chambers: Single wall 304 stainless steel construction fabricated with continuous-seam welds that are ground smooth for easy cleaning and disinfection.
 1. Stainless steel mounting brackets are included. Brackets require 0.25-inch (6 mm) clearance between wall cut-out and pass-through.
 2. Standard mounting is 2 inches (51 mm) from the front of the cleanroom side. One set is welded on the cleanroom side.
 3. Floor Mount models include low-profile access ramps for easy transport of carts. Subtract 1 inch (25 mm) from internal vertical clearance to compensate for ramps.

4. Standard Features: Designed to mount on walls of various sizes and thicknesses:
 - a. Continuous seams create smooth, easy-clean interiors.
 - b. Lifting latches eliminate hinge strain for long service life.
 - c. Isolated interlocks prevent both doors from being open simultaneously.
 - d. One-piece, heat-formed gaskets will not creep, deform or outgas.
 5. Options:
 - a. Stainless Steel ULPA-Filtered Air Shower Cat. #1993-11A.
 - b. Ventilation System: Remove particles from make-up air. Cat. #6705-24.
 - c. CleanTops sloped for easier wipe-down.
 6. UV sterilization
 7. Foot-operated doors
 8. Stainless steel shelves on chrome-plated racks with height adjustment in 2 inch (51 mm) increments.
- B. CleanSeam 304 Stainless Steel Pass-Through Chambers:
1. Wall Mount
 - a. Cat. #2636-06D, FirmLok Interlock 6705-52A
 - 1) Outside Dimensions: 27 inches by 28 inches by 27 inches (689 mm by 711 mm by 689 mm)
 - 2) Inside Dimensions: 24 inches by 24 inches by 24 inches (610 mm by 610 mm by 610 mm)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until openings and substrates have been properly prepared.
- B. Verify exact location of clean room pass-throughs for installation.
- C. Verify that rough openings and surfaces are ready to receive work.
- D. If opening and substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

- C. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install pass-throughs, plumb and level. Seal the perimeter of both sides of the opening as required.
- C. Upon completion of installation operate unit and make necessary adjustments.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 132113.13

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SECTION 134900 - RADIATION PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lead sheet, strip, and plate.
2. Lead glass.
3. Lead-lined building materials and products including the following:
 - a. Gypsum board.
 - b. Wood doors.
 - c. Observation-window frames.
4. Informational signs.

B. Related Sections:

1. Section 092900 "Gypsum Board" for metal framing and furring for lead-lined gypsum board and for finishing materials, accessories, and trim applied to lead-lined gypsum board.
2. Division 26 Sections for conduit, wire, and switch boxes for connecting components of neutron-shielding doors, including operators.

1.2 DEFINITIONS

A. Lead Equivalence: The thickness of lead that provides the same attenuation (reduction of radiation passing through) as the material in question under the specified conditions.

1. Lead equivalence specified for materials used in diagnostic x-ray rooms is as measured at 100 kV, unless otherwise indicated.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide materials and workmanship, including joints and fasteners, that maintain continuity of radiation protection at all points and in all directions equivalent to materials specified in thicknesses and locations indicated.

1. Materials, thicknesses, and configurations indicated are based on radiation protection design prepared by Owner's radiation health physicist. This design is available to Contractor on request.

B. Lead-Lined Assemblies: Unless otherwise indicated, provide lead thickness in doors, door frames, window frames, penetration shielding, joint strips, film transfer cabinets, and other

items located in lead-lined assemblies not less than that indicated for assemblies in which they are installed.

- C. Lead Glazing: Unless otherwise indicated, provide lead equivalence not less than that indicated for assembly in which glazing is installed.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show layout of radiation-protected areas. Indicate lead thickness or lead equivalence of components. Show components and installation conditions not fully dimensioned or detailed in Product Data.
 - 1. Show ducts, pipes, conduit, and other objects that penetrate radiation protection together with details of penetrations.
- C. Samples for Initial Selection: For each type of prefinished item indicated.
- D. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for installation of radiation protection indicated.
- B. Source Limitations: Obtain each type of radiation protection product through one source from a single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to radiation protection including, but not limited to, the following:
 - 1. Sequence and schedule of radiation protection work in relation to other work.
 - 2. Supplementary lead shielding at duct, pipe, and conduit penetrations of radiation protection.
 - 3. Methods of attaching other construction and equipment to lead-lined finishes.
 - 4. Notification procedures for work that requires modifying radiation protection.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver materials in original packages, containers, or bundles bearing the brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
- C. Lead-Lined Gypsum Panels: Neatly stack panels flat to prevent deformation.

- D. Lead-Lined Wood Doors: Comply with requirements in Section 081416 "Flush Wood Doors" for delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 MATERIALS

- A. Lead Sheet, Strip, and Plate: ASTM B749, alloy UNS No. L51121 (chemical-copper lead).
- B. Lead Glass: Lead-barium, polished plate glass containing more than 60 percent heavy metal oxides, including 55 percent lead oxide by weight.
1. Manufacturers:
 - a. Amerope Enterprises, Inc.
 - b. MarShield Custom Radiation Products.
 - c. McGrory Glass, Inc.
 - d. Radiation Protection Products.
- C. Lead-Lined Gypsum Board: 5/8-inch-thick gypsum board complying with Section 092900 "Gypsum Board," of width and length required for support spacing and to prevent cracking during handling, and with a single sheet of lead laminated to the back of the board.
1. Provide lead lining full width and length of board.
 2. Provide 3-inch- wide lead strips for wrapping metal stud flanges.
 3. Provide 2-inch- wide lead strips for backing joints.
 4. Provide 5/8-inch lead disks for covering screw heads.
 5. Provide lead-headed nails for fastening gypsum board, accessories, and trim to wood members.
- D. Accessories and Fasteners: Provide manufacturer's standard fasteners and accessories as required for installation, maintaining same lead equivalence as rest of system.

2.3 MANUFACTURED UNITS

- A. Lead-Lined Wood Doors: Flush wood doors with lead lining.
1. Manufacturers:
 - a. A & L Shielding Inc.

- b. Ambico Limited.
 - c. Ameray Company.
 - d. Atomic International.
 - e. Curries; an ASSA ABLOY Group company.
 - f. Masonite Architectural Doors.
 - g. Oshkosh Door Company.
 - h. Radiation Protection Products, Inc.
 - i. Ray-Bar Engineering Corp.
2. Door Construction: Veneer face, five ply, bonded particleboard core.
 3. Lead Lining: One or more continuous sheets of lead extending from top to bottom and edge to edge, constructed between the core and faces. Do not place lead lining at door centerline.
 4. Comply with Section 081416 "Flush Wood Doors" for grade, faces, veneer matching, fabrication, finishing, and other requirements, unless otherwise indicated.
 5. Factory fit doors to suit frame openings indicated with 1/16-inch clearance at heads and jambs and minimum clearance at bottom. Factory machine doors for hardware not surface applied.
 6. Shield cutouts for locksets with lead sheet of same thickness used in door. Lap lining of cutouts with door lining.
 7. Prepare doors to receive view windows and louvers as indicated. Provide removable wood stops for glazed openings.
 8. Provide lead-lined astragals for pairs of doors.
- B. Lead-Lined Observation-Window Frames: Fabricate from 0.0428-inch-thick, formed-steel sheet or 0.064-inch-thick aluminum extrusions with mitered corners, welded or bolted with concealed fasteners.
1. Line with lead sheet formed to match frame contour, continuous in each jamb and across head and sill, lapping the stops, and fabricated wide enough to maintain an effective lap with lead of adjoining assemblies.
 2. Construct so lead lining overlaps glazing material perimeter by at least 3/8 inch and provide removable stops.
 3. Form sill with an opening for sound transmission. Offset sound passage to make opening lightproof and to maintain required lead equivalence at all points and in all directions.

2.4 INFORMATIONAL SIGNS

- A. Informational Signs: High-pressure-laminate engraving stock with contrasting face and core, machine engraved from master templates for accurately formed letters, numbers, and symbols.
1. Color: As selected by Architect from manufacturer's full range of colors.
 2. Provide copy indicated or as directed.
 3. Indicate lead equivalence in millimeters and heights of radiation protection in inches.
- B. Rooms Where the Level of Protection Is Uniform Throughout: Provide one sign for each room indicating lead equivalence of partitions, ceilings, floors, doors, and other portions of radiation protection enclosure. Indicate height of radiation protection above floor or indicate that partitions are radiation protected to full height.

- C. Rooms Where the Level of Protection Is Not Uniform Throughout: Provide one sign for each room with different lead equivalences in different locations. Indicate, in tabular form, lead equivalence of each wall, partition, ceiling, floor, door, and window. Indicate height of radiation protection above floor or indicate that partitions are radiation protected to full height. Indicate where lead equivalence changes or is not continuous.
- D. Rooms Where Some Partitions Are without Radiation Protection: Provide one sign for each partition that contains radiation protection and indicate its lead equivalence. Indicate height of radiation protection above floor or indicate that partitions are radiation protected to full height.
- E. Rooms Where Only the Door Has Radiation Protection: Provide one sign for each door indicating its lead equivalence.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates in areas to receive radiation protection, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of radiation protection.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Concrete Surfaces: Proceed with installation only after surfaces are clean, dry, and free of depressions and sharp projections that could damage or penetrate lead sheet.

3.2 INSTALLATION OF LEAD-LINED GYPSUM BOARD

- A. Install with long edge parallel to supports and lead lining facing supports. Provide blocking at end joints.
- B. Fastening to Metal Supports: Use steel drill screws spaced as recommended in writing by gypsum-board manufacturer. Apply lead disks over screw heads and recess flush with surface of board.
 - 1. Install lead strips, 1-1/2 inches wide minimum and same thickness as lead lining, to face of supports and blocking where joints occur. Secure lead strips with construction adhesive. Provide shims at intermediate supports.
 - 2. Apply lead disks recessed flush with surface of board over heads of screws securing trim.
- C. Two-Layer System: Apply a facing sheet of gypsum board vertically over base sheet using laminating adhesive recommended in writing by gypsum-board manufacturer. Offset joints in finish layer from joints in base layer and fasten at top and bottom of sheet to support finish panel until adhesive has set.
 - 1. Locate fasteners above ceiling or behind wall base and cover fasteners with lead disks recessed flush with surface of board.

- D. Openings: Extend lead-lined gypsum board into frames of openings, lapping lead lining with lead frames or frame linings at least 1 inch. Arrange board around openings so neither horizontal nor vertical joints occur at corners of openings.

3.3 INSTALLATION OF DOORS AND FRAMES

- A. Install lead-lined steel door frames according to Section 081113 "Hollow Metal Doors and Frames," unless otherwise indicated.
- B. Install lead-lined wood doors according to Section 081416 "Flush Wood Doors," unless otherwise indicated.
- C. Lap lead lining of frames over lining in walls at least 1 inch.
- D. Lead Lining of Frames: Line inside of frames with lead of thickness not less than that required in doors and walls where frames are used. Form lead to match frame contour, continuous in each jamb and across the head, lapping the stops. Form lead shields around areas prepared to receive hardware. Lap lining over lining in walls at least 1 inch.
- E. Line astragals with lead sheet.
- F. Hardware: Line covers, escutcheons, and plates to provide effective shielding at cutouts and penetrations of frames and doors. See Section 087100 "Door Hardware" for other installation requirements.
- G. Touch up damaged finishes with compatible coating after sanding smooth.
- H. Check and readjust operating hardware items, leaving doors and frames undamaged and in proper operating condition.

3.4 INSTALLATION OF PENETRATING ITEMS

- A. At penetrations of lead linings, provide lead shields to maintain continuity of protection.
- B. Provide lead linings, sleeves, shields, and other protection in thickness not less than that required in assembly being penetrated.
- C. Secure shields at penetrations using adhesive or wire ties but not penetrating fasteners, unless indicated on Drawings.
- D. Outlet Boxes and Conduit: Cover or line with lead sheet lapped over adjacent lead lining at least 1 inch. Wrap conduit with lead sheet for 10 inches from box.
- E. Duct Openings: Unless otherwise indicated, line or wrap ducts with lead sheet for distance from partition/ceiling equal to three times the largest opening dimension. Lap lead sheet with adjacent lead lining at least 1 inch.
- F. Piping: Unless otherwise indicated, wrap piping with lead sheet for 10 inches from point of penetration.

3.5 FIELD QUALITY CONTROL

- A. Field Inspection: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Correct deficiencies in or remove and replace radiation protection that inspection reports indicate does not comply with specified requirements.
- C. Testing: After radiology equipment has been installed and placed in operating condition, Engage a radiation health physicist to test radiation protection.
- D. Correct deficiencies in or remove and replace radiation protection that testing indicates does not comply with specified requirements, including finishes and other work covering defective work.
- E. The Owner reserves the right to employ a qualified independent testing and inspecting agency and/or health physicist to conduct separate quality control tests.

3.6 PROTECTION

- A. Lock radiation-protected rooms once doors and locks are installed and limit access to only those persons performing work in the rooms.

END OF SECTION 134900

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DIVISION 21– FIRE PROTECTION SPECIFICATIONS
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SECTION 210501 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 21 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 21 specifications contain statements more definitive or more restrictive.
- C. Nothing herein contained shall be so construed to relieve the Contractor from doing his work according to the true intent and meaning of these drawings and specifications. He will be held to provide and install all materials and equipment and shall furnish all labor necessary for the complete, prompt and satisfactory execution of the work. He is also responsible for the proper coordination of his work with all other trades.
- D. The Contractor shall bear all expenses incidental to the satisfactory completion of the work contained in these specifications and drawings.

1.2 SCOPE

- A. Perform work and provide material and equipment as shown on Drawings and/or as specified and/or indicated in this Section of the Specifications. Completely coordinate work of Divisions 21 with work of other trades and provide a complete and fully functional installation.
- B. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.
- C. It is the intent that these Specifications and Drawings are to establish minimum requirements for methods, products and equipment and to provide electrical service, distribution and systems finished, tested and ready for operation. Incidental detail not usually shown or specified, but necessary for proper installation and operation shall be included in the work and this Contractor's estimate, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each raceway and piece of equipment to minimize conflicts with other trades.
- D. Give notices, file plans, obtain permits and licenses, pay fees and back-charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

- E. Division 21 Contractor shall furnish all motor starters and disconnect switches as required by NEC for motors, unless specifically noted otherwise in the specifications or on the drawings. Motor starters and disconnect switches shall be in accordance with Division 26 Specifications.
- F. If a Guaranteed Maximum Price (GMP) has been prepared using documents prior to the issuance of the 100% Bid Documents, the Contractor shall identify any and all changes to the documents (both drawings and specifications) that are affecting the GMP, either increasing or decreasing the GMP amount. All changes shall be numbered and circled, in both drawings and specifications. The Contractor shall also provide detailed cost back-up for all items noted above.
- G. Work consists of furnishing all labor, material, equipment and services necessary and reasonably incidental to the proper completion and proper operation of the fire protection systems. The work shall consist of but shall not necessarily be limited to the following:
 - 1. Automatic wet and dry pipe sprinkler systems in the buildings as indicated, including hydraulic calculations.
 - 2. Wet pipe automatic sprinkler systems as specified in Section 212313.
 - 3. Dry pipe automatic sprinkler systems as specified in Section 211316.
 - 4. Fire Pump system as specified in Section 213001.
 - 5. Piping materials and installation instructions common to most piping systems.
 - 6. Mechanical sleeve seals.
 - 7. Sleeves.
 - 8. Escutcheons.
 - 9. Grout.
- H. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 21 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 21 specifications contain statements more definitive or more restrictive.
- I. Nothing herein shall be so construed to relieve the Contractor from doing his work according to the true intent and meaning of the drawings and specifications. He will be held to provide and install all materials and equipment, and shall furnish all labor necessary for the complete, prompt and satisfactory execution of the work. Also he is responsible for properly coordinating his work with all other trades.
- J. The contractor shall bear all expenses incidental to the satisfactory completion of the work contained in these specifications and drawings.
- K. The Contractor shall coordinate water service requirements in accordance with the local water utility regulations, including required permits, backflow preventers, meters, piping, valves, bypasses, supports and other accessories.
- L. The contractor shall perform a two hydrant flow test on the portion of the public water system serving the project site. This flow test shall conform to the requirements defined in NFPA 13 and

shall identify the location of the tested hydrants and their relationship to the location of the water supply tap. The elevation of the test hydrants as it related to the Project shall be included. The time of day of the test shall also be recorded. This test shall be coordinated with and conform to the requirements of the local authority having jurisdiction. This flow test shall be used as the hydraulic basis for all fire protection systems included in the Project. The flow test shall be made prior to the development of sprinkler system shop drawings and system hydraulic calculations. All cost associated with the flow test shall be paid by the contractor. The flow test shall be submitted to the Architect and Engineer within ninety (90) days of notice to proceed.

M. The Contractor shall affix the seal of the registered professional engineer or the NICET Level III designer to all submitted system drawings and hydraulic calculations as required by the State of North Carolina General Statutes.

N. Related Sections:

1. All specifications section relate to the section herein.

1.3 DEFINITIONS AS USED IN THESE SPECIFICATIONS

A. "Provide," means "furnish and install."

B. "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support."

C. "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."

D. "Architect" means the "Prime Design Consultant," and if United Engineering Group, Inc. is not the prime design consultant, the Architect may authorize United Engineering Group to act on the Architect's behalf in matters concerning the Division 21 series of specifications.

E. "RFI" means Contractor's "Request for Information."

F. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

G. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

H. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

I. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

J. 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.

K. The following are industry abbreviations for plastic materials:

1. Retain abbreviations that remain after this Section has been edited.

2. ABS: Acrylonitrile-butadiene-styrene plastic.
 3. CPVC: Chlorinated polyvinyl chloride plastic.
 4. PE: Polyethylene plastic.
 5. PVC: Polyvinyl chloride plastic.
- L. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.4 CONTRACT DOCUMENTS

- A. Listing of Drawings does not limit responsibility of determining full extent of work required by these Contract Documents. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, Site Utility and all other Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of Division 21 must be coordinated.
- B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.
- D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.
- E. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.
- F. Data that may be furnished electronically by the Architect (on computer tape, diskette, or otherwise) is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not substitute for Architect's sealed or stamped construction documents.

1.5 DISCREPANCIES IN DOCUMENTS

- A. Where Drawings or Specifications conflict or are ambiguous, the contractor shall advise the Architect in writing before Award of Contract. Otherwise, Architect's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or ambiguities thus resolved.

- B. Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert Architect in writing before installation. Otherwise, make changes in installed work as Architect requires within Contract Price.
- C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specifications, this contractor shall provide that material, installation, or work which is of the higher, more stringent standard.
- D. It is a requirement of these Contract Documents to have the contractor provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the Contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.
- E. In cases covered by Paragraph (D) above, where the Contractor believes he needs engineering guidance, he shall submit a sketch identifying his proposed solution and the Architect shall review and advise the contractor of the disposition.

1.6 MODIFICATIONS IN LAYOUT

- A. Fire Protection Drawings are diagrammatic. They indicate general arrangements of fire suppression systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.
- B. In order to obtain the Architect's desired aesthetics in spaces used by building occupants, in all such spaces, prior to installation of visible material and equipment (including access panels) review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.
- C. Check Contract Documents, as well as, Submittals and Shop Drawings of all subcontractors to verify and coordinate spaces in which work of Divisions 21 will be installed.
- D. Maintain maximum headroom at all locations. All piping, duct, conduit and associated components to be as tight to underside of structure as possible.
- E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C and D above. Systems shall be run in a rectilinear fashion.
- F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

1.7 REQUESTS FOR INFORMATION (RFI'S)

- A. If the RFI is a request to resolve a conflict or an ambiguity, or a request for additional detail, Contractor's RFI shall include a sketch or equivalent description of Contractor's proposed solution, in accordance with paragraphs 1.5 (E) and 1.6 (F) above.
- B. To expedite the flow of RFI's, for all RFI's under Divisions 21, Contractor shall submit the attached form, or similar form including the same information, to the Architect, with copy to United Engineering Group. Contractor shall include proposed solution in the indicated space on the form.

1.8 REFERENCES

- A. The Contractor shall comply with all laws, ordinances, and regulations of all authorities having jurisdiction, including those of all applicable city, county, state, federal and public utility entities. The Contractor shall obtain all licenses, permits, etc. and shall pay all associated connection fees, tapping fees, inspection fees, etc. This cost shall be included in the contract price.
- B. The publications listed below form a part of this specification. All publications shall be the latest edition as adopted by the authority having jurisdiction. The publications are referred to in the text as necessary. The minimum standard of work under this contract shall be in accordance with the following model building codes and standards:
 - 1. North Carolina State Building Codes:
 - a) Building Code – 2018 edition
 - b) Fire Prevention Code – 2018 edition
 - 2. National Fire Protection Association
 - a) NFPA 13 - Standard for the Installation of Sprinkler Systems.
 - b) NFPA 14 - Standard for the Installation of Standpipe and Hose Systems
 - c) NFPA 20 - Standard for the Installation of Centrifugal Fire Pumps
 - d) NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances
 - e) NFPA 70 - National Electrical Code
 - 3. North Carolina Department of Insurance
 - a) Requirements for Automatic Sprinkler Systems
- C. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- D. Air Movement and Control Association International, Inc.:
 - 1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- E. American National Standards Institute (ANSI):
 - 1. ANSI A21.4 / AWWA C104 – Cement Mortar Lining for Ductile-Iron Pipe
 - 2. ANSI A21.11 / AWWA C111 – Rubber Gasket Joints for Ductile-Iron Pipe

3. ANSI A21.51 / AWWA C151 – Ductile-Iron Pipe
 4. ANSI B16.4 – Cast Iron Screwed Fittings
 5. ANSI B16.12 – Cast Iron Drainage Fittings, Threaded
 6. ANSI B16.15 – Pipe Fittings, Bronze, and 250 lb. Cast
 7. ANSI B16.18 – Cast Copper Allow Solder-Joint Pressure Fittings
 8. ANSI B16.22 – Solder-Joint Fittings, Pressure Wrought Copper and Copper Alloy
 9. ANSI B16.23 – Cast Copper Alloy Solder-Joint Drainage Fittings
 10. ANSI B16.24 – Bronze Pipe Flanges and Flanged Fittings
 11. ANSI B16.29 - Solder-joint fittings, Drainage, DWV Wrought Copper and Copper Alloy
 12. ANSI S1.4 - Sound Level Meters.
 13. ANSI S1.8 - Reference Quantities for Acoustical Levels.
 14. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
 15. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.
- F. Air-Conditioning and Refrigeration Institute:
1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.
- G. American Society of Heating, Refrigerating and:
1. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
 2. ASHRAE Handbook - HVAC Applications.
- H. American Society of Mechanical Engineers (ASME):
1. ASME A13.1 - Scheme for the Identification of Piping Systems.
 2. ASME B31.9 - Building Services Piping.
 3. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 4. ASME B16.11 - Forged Steel Fittings - Socket-Welding and Threaded.
 5. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 6. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 7. ASME B16.25 – Butt-welding Ends.
 8. ASME B16.3 - Malleable Iron Threaded Fittings.
 9. ASME B16.4 - Gray Iron Threaded Fittings.
 10. ASME B16.5 - Pipe Flanges and Flanged Fittings.
 11. ASME B16.9 - Factory-Made Wrought Steel Butt-welding Fittings.

12. ASME B31.1 - Power Piping.
 13. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
 14. ASME B40.1 - Gages - Pressure Indicating Dial Type - Elastic Element.
 15. ASME - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels.
 16. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- I. American Society of Testing and Materials (ASTM) International:
1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. ASTM A106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 3. ASTM A135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.
 4. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 5. ASTM A795 - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 6. ASTM B32 - Standard Specification for Solder Metal.
 7. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 8. ASTM B247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
 9. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 10. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.
 11. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 12. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 13. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
 14. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
 15. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures
 16. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
 17. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- J. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

2. AWS D1.1 - Structural Welding Code - Steel.
- K. American Water Works Association (AWWA):
1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
 2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 3. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- L. FM Global:
1. FM P7825 - Approval Guide, (Factory Mutual).
 2. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- M. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- N. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.
- O. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 67 - Butterfly Valves.
 3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 4. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 5. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 6. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 7. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 8. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 9. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- P. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 2. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
 3. NEMA MG 1 - Motors and Generators.
- Q. National Fire Protection Association:

1. NFPA 13 - Installation of Sprinkler Systems.
2. NFPA 13R - Standard for Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height.
3. NFPA 14 - Standard for the Installation of Standpipe, Private Hydrants and Hose Systems.
4. NFPA 20 - Standard for the Installation of Centrifugal Fire Pumps.
5. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
6. NFPA 70 - National Electrical Code.
7. NFPA 72 - National Fire Alarm Code.
8. NFPA 99 - Standard for Health Care Facilities.
9. NFPA 2001 - Clean Agent Fire Extinguishing Systems.

R. Underwriter Laboratories, Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 393 - Indicating Pressure Gages for Fire-Protection Service.
3. UL 404 - Gages, Indicating Pressure, for Compressed Gas Service.
4. UL 448 - Pumps for Fire Protection Service.
5. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
6. UL 778 - Motor Operated Water Pumps.
7. UL 1478 - Fire Pump Relief Valves.
8. UL 1479 - Fire Tests of Through-Penetration Firestops.
9. UL 1887 - Fire Tests of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.
10. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
11. UL - Fire Protection Equipment Directory.
12. UL - Fire Resistance Directory.
13. Warnock Hersey - Certification Listings.

1.9 SUBMITTALS

- A. Section 210502 – Fire Protection Shop Drawings and Submittals, Substitutions and O&M Manuals
- B. The Contractor shall submit Certificates of Compliance for the following:
 1. Schedule of UL listed through penetration assemblies

1.10 ELECTRICAL EQUIPMENT

- A. Refer to Section 210503 of this manual for the requirements relating to electrical equipment.

1.11 CONTROL WIRING

- A. Refer to Section 210503 of this manual for the requirements relating to wiring

1.12 QUALITY ASSURANCE

- A. The Contractor shall coordinate his work with that of the other trades. Where interference with other trades occurs, the Contractor shall present his solutions to the Professional. The Professional shall make the final decision regarding changes to be made in the work.
- B. The Contractor shall thoroughly familiarize himself with all specifications and drawings for the project so that he clearly understands his responsibility in relationship to the work to be performed. The Contractor shall plan and perform his work so as to permit the use of the building at the earliest possible date.
- C. The Contractor shall guarantee all work, materials and equipment, furnished against defects, leaks, performance and non operation for a period of one (1) year after the date of the Owner's final acceptance. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.
- D. The Contractor shall expressly and completely follow all manufacturers' instructions required for validation of the manufacturer's warranty agreement including but not limited to service, maintenance and adjustments of the equipment.
- E. The Contractor is responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the contract documents.
- F. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- G. 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.
- H. Electrical Characteristics for Fire-Suppression 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.

1.13 CLOSEOUT SUBMITTALS

- A. Division 01- Execution and Closeout Requirements.
- B. Project Record Documents: Record actual locations of components and tag numbering.
 - 1. Changes from the contract drawings necessary to coordinate the work with other trades, to conform to the building conditions or to conform to the rules and regulations of authorities

- having jurisdiction shall be made only after obtaining written permission from the Professional.
2. The Contractor shall keep a record of construction changes and deviations from the original contract drawings. All changes shall be recorded on a separate set of prints, which shall be kept at the job site specifically for that purpose. The record shall be made immediately after the work is completed. Documentation shall include the following:
 - a) Location and elevation of new and existing utility lines.
 - b) Points of connection to existing utility lines.
 - c) Changes in pipe routing location.
 - d) Valve locations.
 - e) Equipment locations, etc.
 - f) Actual capacities and values of equipment provided as indicated in equipment schedules
 3. The marked up record set of drawings shall be delivered to the Professional before final acceptance of the fire protection contract work.
 4. Operation and Maintenance Data: Submit spare parts lists.

1.14 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 Fire Protection 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. Maintain one copy of each document on site.

1.15 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. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.
- C. The Contractor shall be licensed by the North Carolina State Board of Examiners of Plumbing, Heating, and Fire Sprinkler Contractors. The contractor may be required to furnish evidence of

satisfactory performance on previous sprinkler system installations of equivalent size, type, and complexity.

1.16 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.
- C. The Contractor is responsible to verify the location of any and all existing underground utilities in the vicinity of his work. When it has been indicated that these utilities are to remain in place, the Contractor shall provide adequate means of support and protection during excavation operations.
- D. Before ordering any equipment and material, or performing any work, the Contractor shall verify all measurements and dimensions at the job site. The Contractor is responsible for the correctness of this information.
- E. No extra compensation will be considered based on differences between actual dimensions and measurements and those indicated on the drawings.
- F. Any differences identified by the Contractor shall be submitted to the Professional for consideration before proceeding with the work.

1.17 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Deliver and store valves in shipping containers, with labeling in place.
- C. At his own expense, the Contractor shall protect his work, materials or equipment that is subjected to damage during the project duration. All openings into any piping, ducts or equipment shall be securely covered, or otherwise protected, to prevent injury due to carelessly or maliciously dropped tools or materials, grit, dirt, or any foreign material. The Contractor is responsible for all damage until his work is fully and finally accepted.
- D. The Contractor is responsible to provide protection for motors, pumps, electrical equipment, and all similar items of equipment from dirt, grime, plaster, water, etc. during all phases of construction. This protection shall be provided by covering equipment with transparent plastic sheeting and/or locating the materials and equipment in an area free from the elements.
- E. Furnish cast iron and steel valves with temporary protective coating.
- F. 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.

1.18 COORDINATION

- A. All existing service utilities shall remain active during the construction. Any service underground, aboveground, interior or exterior damaged, broken, or otherwise rendered inoperative during the course of construction due to activities on the part of the Contractor shall be properly repaired by the Contractor, at his own expense. The method used in repairing, replacing or maintaining the services shall be submitted to the Professional for review and approval.

1. The Contractor shall schedule his work to avoid any major interruption of any utility services.
 2. Existing utilities serving occupied facilities shall not be interrupted except when such interruptions have been authorized in writing by the Owner or the Professional. Interruptions may occur only after acceptable, temporary utility services have been provided. The Contractor shall provide a minimum of ten (10) working days notice to the Professional and receive written notice to proceed before interrupting any utility.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 - Access Doors and Frames.

1.19 CONCRETE

- A. Concrete shall comply with Division 03 of the Project Manual.
- B. Reinforcing shall conform to ASTM A 615, Grade 60. Concrete exposed to freezing and thawing, salts, sulfates and corrosion shall comply with North Carolina State Building Code.
- C. All concrete shall be of minimum 3000 pounds per square inch (psi) strength in (twenty-eight) 28-days. All concrete shall be mixed by machine. No wet or moistened mixture containing cement shall remain unplaced for a period exceeding (thirty) 30-minutes and shall not be used after its initial set. Re-tempering after initial set is prohibited. Exposed surfaces shall be protected from drying for at least (seven) 7-days. All forms shall be built true and rigid. Form removal shall not injure the concrete.
- D. All concrete is to be finished with a hard, smooth toweled finish and is to be faced smooth with rounded corners.

1.20 PAINTING

- A. All exposed piping within finished areas shall be painted to match the adjacent surfaces. Refer to the architectural finish schedules for color selections.
- B. Properly prepare all surfaces before applying paint. Remove all foreign material and clean surface to be painted according to the paint manufacturer's recommendations.
- C. Apply proper primers and sealers as recommended by paint manufacturer.
- D. Refer to Division 09 – Painting for additional information regarding materials and requirements.
- E. All sprinkler heads installed in the piping system to be painted shall be covered with protective baggies by the fire sprinkler contractor as they are installed. Once the painting is complete the baggies shall be removed as directed by the contractor. Any painted or damaged sprinkler heads shall be replaced at no additional cost to the Owner.
- F. Refer to Division 21 Sections for additional information regarding the painting of piping.

1.21 RELATED WORK

- A. All work related to providing complete fire protection systems and equipment is the responsibility of the Contractor. The following related work shall be provided as indicated in other specification divisions, unless noted otherwise, but shall remain the responsibility of the Contractor for workmanship and completeness:
1. General Contractor
 - a) Installation of access panels.
 - b) Final painting of existing walls, floors and ceilings where the surfaces are being refinished and remodeled under the General Contract. Refer to General Construction Drawings.
 2. Mechanical Contractor
 - a) Coordinate equipment, ducts and pipes for interference with fire protection system installation and performance.
 3. Electrical Contractor
 - a) Verification of the proper rotation of three-phase equipment, and making modifications as required correcting improper rotation.
 - b) Installation of all combination starters/-disconnects and overload protectors.
 - c) Coordinate equipment, ducts and pipes for interference with fire protection system installation and performance.

1.22 MISCELLANEOUS STEEL AND ACCESSORIES

- A. The Contractor shall provide all necessary steel angles, channels, pipe, rods, nuts, bolts, etc., as shown on plans, as specified, or as may be required for complete and proper installation of plumbing fixtures, systems and equipment. All material and workmanship shall be of the best quality and shall be installed in accordance with the best practices of the trade.

1.23 ACCESS PANELS

- A. The Contractor shall furnish access doors to the General Contractor for installation in ceilings, walls, partitions and floors for access to valves and other appurtenances.
- B. Access panels shall be of sufficient size to permit removal or access to equipment, except that the minimum size shall be (twelve) 12-inches by (sixteen) 16-inches.
- C. Access door locations shall be as determined by field conditions for optimum access to equipment, and shall be reviewed by the Professional before final installation, and shall be subject to the following:
1. Bottom of access doors shall not be lower than the top of the partition base, or minimum of (six) 6-inches above floor.
 2. Tops and/or sides of access panels shall be a minimum of (six) 6-inches from the ceiling or opening or from the edge of a wall return.

- D. doors shall be suitable for installation in the finish material of the ceilings, walls, partitions and floors.
- E. Frame and panel access doors in restrooms, kitchens and as indicated shall be stainless steel.
- F. Access doors with UL Listing shall be provided in rated construction assemblies. Access doors shall be "B Label" and shall have a UL one and one-half (1 1/2) hour rating at 250 degrees F rating for both door and frame. Maximum size shall be 20" x 20" or 400 square inches in area. Frame shall be sixteen (16) gauge minimum steel. The panel shall be twenty (20) gauge minimum steel. Access doors shall be provided with a baked on enamel finish (prime coat), continuous type hinge on one side, flush face type lock with key operation and self latching cylinder locks.
- G. Access doors without UL label shall be provided in all non-rated construction assemblies. Frame shall be sixteen (16) gauge minimum steel. The panel shall be fourteen (14) gauge minimum steel. Access doors shall be provided with a baked on enamel finish (prime coat), concealed spring type hinges and flush-face type lock with key operation and self-latching cylinder locks. Door shall open 175 degrees (minimum).
- H. All access doors shall be keyed alike.

1.24 CLEANUP

- A. The Contractor shall maintain buildings, grounds and public properties free from accumulations of waste materials, debris and rubbish. At reasonable intervals during the progress of work, and when directed by the Owner's authorized representative, the site and public properties shall be cleaned. All waste materials, debris and rubbish shall be disposed of in appropriate manner. The Contractor shall provide containers for collection of waste materials, debris and rubbish. Waste materials, debris and rubbish shall be removed from the job site and legally disposed of at a landfill area in accordance with all applicable regulations. Burning or burying waste materials, debris or rubbish on project site is prohibited.
- B. At the completion of the project, the Contractor shall remove waste materials, rubbish, tools, equipment, machinery, surplus materials, etc., and clean all sight exposed fire protection fixtures and equipment. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight exposed fire protection fixtures and equipment. Broom clean paved and concrete surfaces. Rake clean other ground surfaces. Repair, patch and touch up marred surfaces to the specified finish or to match adjacent surfaces.

1.25 INSPECTION AND TESTING

- A. New fire protection systems and parts of existing systems, which have been altered, extended or repaired, shall be tested to disclose leaks and defects.
- B. The Contractor shall develop a written test procedure for the Project. This procedure shall meet the requirements defined in NFPA 13. The test procedure shall be submitted to the Design Team for review a minimum of four (4) weeks before any testing begins.
- C. The sprinkler system testing shall include all of the system components including flow switches and tamper switches. The system shall be complete including the interfaces with the building fire alarm system prior to any system demonstrations.

- D. The Contractor shall notify the Professional a minimum of five (5) working days prior to testing to coordinate the testing and inspection procedures.
- E. If the Professional determines that the fire protection systems do not pass the prescribed tests, then the Contractor shall be required to make the necessary repairs, at his own expense, and the Contractor shall re-inspect and re-test the systems. Repairing, inspection and testing shall be continued until all systems pass as determined by the Professional.
- F. All new, altered, extended or replaced fire protection shall be left uncovered and unconcealed until it has been inspected, tested and accepted by the Professional. Where such work has been covered or concealed before it has been inspected, tested and accepted, it shall be uncovered by the Contractor, at his own expense as directed by the Professional.
- G. All equipment, material, labor, etc. required for testing the fire protection systems shall be furnished by the Contractor.

1.26 INSTRUCTION OF THE OWNER

- A. After acceptance of the Project, the Contractor shall furnish the services of personnel thoroughly familiar with the completed installation to instruct the Owner in the proper operation and maintenance of all equipment and appurtenances provided.
- B. The Contractor shall provide the Owner with two weeks advance notice before the instruction session.

1.27 CUTTING, PATCHING, FINISHING

- A. Unless otherwise noted, the Contractor shall cut, patch and finish all chases and openings required for the installation of work to be performed under this Contract. All patching and finishing shall match existing adjacent undisturbed surfaces.
- B. Cutting shall not cause damage to the building or leave unsightly surfaces. The Contractor is responsible for the repair of these conditions.
- C. The Contractor shall contact the holder of the roofing guarantee and obtain his written approval before cutting the roofing membrane.
- D. No structural member shall be cut.
- E. Penetrations made in existing fire rated chases, partitions, floors, etc. shall be sealed with an approved material and method as required to maintain the integrity of the fire separation.
- F. All materials and methods to be used for patching and repairing shall be subject to the approval of the Professional and the Owner's Authorized Representative.
- G. The Contractor shall set all sleeves, hangers, and anchors required for the Fire Protection Contract work and shall be responsible for their proper and permanent location.
- H. No cutting shall be done which may affect the building structurally or architecturally without first securing the approval of the Professional. Cutting shall be accomplished in such a manner as not to cause damage to the building or leave unsightly surfaces, which cannot be concealed by plates, escutcheons or other construction. Where such unsightly conditions are caused, the Contractor shall be required, at his own expense, to repair the damaged areas.

- I. Cutting of the construction excessively or carelessly done shall be repaired to match the original work by the Contractor and to the satisfaction of the Professional who will make the final decision with respect to excessive or careless cutting work. The Contractor shall seal all openings he has made in plenum spaces, fire rated floors, ceilings or partitions after his work has been installed. The material used for sealing the openings shall have a fire rating equal to or greater than the rating of the floor, ceiling or partition material.
- J. Where present equipment is removed and unused openings remain in walls, floors, partitions, etc., the Contractor shall properly patch all such openings except as specified under "Work by Others." All patching and repairing shall be done by workmen skilled in this type of work and shall match present or new finishes.
- K. Cutting, patching, and repairing of openings in the existing exterior walls and roof shall be by the General Contractor.

1.28 CHASES AND OPENINGS

- A. All chases and openings required for the installation of the work shall be coordinated with the other trades. The Contractor shall provide the other trades with sufficient time (one (1) week minimum) for coordination of all chases and openings. The Contractor shall be responsible for all work required cutting and patching the required openings. The work shall be performed to the satisfaction of the Professional.
- B. Penetrations made in fire rated chases, partitions, floors, etc. shall be sealed with an approved material and method as required to maintain the integrity of the fire separation.
- C. The Contractor shall provide all sleeves, hangers, and anchors required for installation of the work in chases and openings.

PART 2 PRODUCTS

2.1 PIPE, TUBE AND FITTINGS

- A. All materials used on fire protection systems shall meet the requirements of applicable codes, standards, and requirements of local authorities having jurisdiction and the Owner's insurance carrier.
- B. Refer to individual Division 21 Sections for pipe, tube, and fitting materials and joining methods.

2.2 SLEEVES, MECHANICAL SLEEVE SEALS, ESCUTCHEONS AND GROUT

- A. Refer to individual Division 21 Sections.

2.3 VALVES

- A. Refer to Section 211105 – GENERAL DUTY VALVES FOR FIRE PROTECTION PIPING.

2.4 PIPE HANGERS AND SUPPORTS

- A. Refer to Section 211104 – HANGERS AND SUPPORTS.

PART 3 EXECUTION

3.1 GENERAL

- A. All materials, equipment and accessories specified in this section shall be installed in strict accordance with NFPA 13, NFPA 14, NFPA 20, and North Carolina Department of Insurance.
- B. All piping in finished areas shall be run concealed. The Contractor shall furr in piping or provide soffiting as required and in accordance with the Professional's instructions. All piping shall be installed as required to suit space available in building structure, above suspended ceilings, and other locations found necessary for installation. Install piping as high as possible.
- C. The Contractor shall not install any piping that will interfere with any lights, openings, doors, windows, ductwork, equipment, and existing or special conditions. Headroom in front of openings, doors, or windows shall not be less than the top of the opening. Provide all piping offsets necessary to avoid interference with other work. Piping offsets shall include all devices and assemblies necessary to accommodate the change in direction of the piping.
- D. All piping shall run straight with no more couplings and joints than necessary, shall be grouped wherever practical and shall be carefully installed to provide for proper alignment slope and expansion.
- E. Pipes carrying fluids shall not be installed in transformer vaults, electrical equipment rooms, elevator hoistways, elevator equipment rooms, or similar areas having a collection of electrical equipment. Pipes shall not be installed over, around, in front of, in back of, or directly below, electrical controls, panels, switches, terminals, boxes, or similar electrical equipment.
- F. All materials and equipment used shall be installed in strict accordance with the Standards under which the materials are accepted and approved, and in strict accordance with the manufacturer's instructions.
- G. The contract documents are not intended to indicate every bend, offset, change in direction or appurtenance required to provide a complete and workable system.
- H. The contract drawings are diagrammatic and are indicative of the work to be performed. It is not intended that they show every pipe, fitting or apparatus required for a complete installation.
- I. Except where otherwise indicated, minimum cover of exterior piping shall not be less than three (3) feet.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. All piping shall be installed with not less than 2-inches between finish covering of pipe and all other work or piping.
- E. Reduction in sizes of pipes shall be made with reducing fittings. Bushings will not be permitted.
- F. Bullhead connections in any piping service are prohibited.

- G. All screwed joints shall be made with a non-corrosive, non-hardening compound or Teflon tape applied on the male thread only. All compounds must be approved for the pipe on which they are used. Pipe ends shall be reamed or filed out to size of bore and all chips and cuttings removed. Ends of pipe must be cut square so as to seat in the bottom of the recess in drainage fittings. In making joints in chromium plated brass pipe no more than one thread shall remain exposed when joint is completed. Caulking of screwed joints is not permitted. Pipe joint cement and paint will be permitted only on external threads.

3.3 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems, NFPA 14 for standpipe and hose systems, NFPA 20 for fire pump, and NFPA 24 for service mains.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install pipe sleeve at piping penetrations through footings, partitions, walls and floors. Seal pipe and sleeve penetrations to maintain fire resistance equivalent to fire separation.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping. Riser clamps at exposed locations shall be of such design as to avoid creating a hazardous or unsightly condition and stay within space limitations. Pipe supports are required at the base of all vertical risers and shall be of riser size.
- H. Slope piping and arrange systems to drain at low points. Install eccentric reducers to maintain top of pipe level.

3.4 VALVES

- A. Valves shall be installed at each riser, branch to floor, and where shown on the drawings. Valves shall be installed with stems at or above the horizontal plane.
- B. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
- C. Install gate, ball or butterfly valves for shut-off or isolating service.
- D. Install drain valves at main shut-off valves, low points of piping and apparatus.

3.5 SLEEVES

- A. Sleeves shall be provided for all pipes passing through walls, partitions, floor slabs or roof slabs. Sleeves shall be cut flush with wall, floor or ceiling surfaces except that sleeves through waterproofed roof or floor slabs shall extend above the finished surface. Sleeves shall be sufficient size to allow a sealable annular space between the sleeve and the pipe or between the sleeve and the pipe insulation. All exposed piping passing through floors, walls or ceiling shall be provided with a chrome escutcheon plate securely fastened around the pipe. The annular space

around the pipe in non-water-proof sleeves shall be filled with penetration sealant and smoothed out flush with all surfaces.

- B. All pipe, tube, conduit, or similar through-penetrations of all fire rated walls, floor-ceiling, or roof-ceiling assemblies shall be provided with a fire stopping system to achieve a tight seal that will maintain the fire resistant rating of the assembly containing the through-penetration. Fire stopping system may be sealant or mechanical type.
- C. Sleeves are not required for core-drilled holes.
- D. 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 – “Sheet Metal Flashing and Trim” for flashing.
 - (i) 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 - "Joint Sealants" for materials and installation.
- 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.
 - 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.

- F. 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.
- G. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 07 - "Penetration Fire-stopping" for materials.

3.6 PAINTING AND IDENTIFICATION

A. Painting

1. All painting shall be done in a careful, neat and workmanlike manner, with particular care being exercised to protect building equipment and finishes. All surfaces shall be thoroughly cleaned of rust, scale, dirt, grease, dust, and like items, and sanded so as to provide a bond for new paint. All painted surfaces under this Contract shall be finished in an acceptable manner.
2. All steel piping, equipment, supports, hangers and other iron and steel work in crawl spaces that is not factory painted, coated, or galvanized, installed under this Contract, shall be painted with two (2) coats of Rust-Oleum rust preventative paint, or approved equal. First coat shall be Rust-Oleum No. X-60 red primer, or accepted substitute. The second coat shall be Rust-Oleum No. 634 black gloss, or accepted substitute.

B. Pipe Identification

1. All piping shall be provided with identification markers. Markers shall be provided as follows:
 - a) On straight runs of piping at intervals not exceeding 20-feet.
 - b) Within 2-feet of all elbows.
 - c) Within 2-feet of all piping as it passes through partitions (markers provided on both sides of partitions).

C. Valve Tags

1. The Contractor shall tag each new valve furnished under this contract. The Contractor shall prepare three (3) lists on heavy white paper giving the valve number, its location, and the equipment controlled. One (1) list shall be enclosed in a metal frame under glass and mounted in the building where directed by the Owner. The other two (2) copies shall be delivered to the Architect.

D. Ceiling Panel Identification

1. Provide colored plastic buttons and secure to lay-in ceiling tiles to identify access points for valves.

3.7 INTERFACE WITH OTHER PRODUCTS

A. 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. Install 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.

3.8 PENETRATIONS AND ESCUTCHEONS

A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
2. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
3. Insulated Piping: One-piece, stamped-steel type with spring clips.
4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
5. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
6. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
7. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
8. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
9. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
10. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

3.9 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Clean entire system after other construction is complete.

END OF SECTION 210501

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SECTION 210502 – FIRE PROTECTION SHOP DRAWINGS AND SUBMITTALS,
SUBSTITUTIONS AND O&M MANUALS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. All catalog data, shop drawings, calculations and certificates of compliance shall be submitted as a single package. Failure of the Contractor to provide a complete submittal package may result in delay in processing time. All such delays to the project resulting from the Contractor's failure to provide submittals at one time will be the responsibility of the Contractor.
- C. Fire Sprinkler Contractor: The Contractor shall submit working shop drawings, hydraulic calculations, and product data to the design engineer of record – quantities as listed in the General Conditions or as otherwise indicated in the Division 21 Specifications. Shop drawings should include and be in accordance with working plan requirements of chapter 22 of NFPA 13. Product data should include and identify all material, equipment, and accessory selections to be installed. The hydraulic calculations and shop drawings should be signed by the fire sprinkler designer and include the NC Fire Sprinkler Contractor (FS) license number.
- D. Project Engineer: The specifying engineer (PE) has primary responsibility for review and approval of fire suppression system shop drawings and hydraulic calculations. Specifying Engineer review shall determine compliance with applicable codes and standards and the project contract documentation.

1.2 DEFINITIONS

- A. Shop Drawings: Project shop drawings and other data prepared specifically for fulfillment of the project requirements. Shop drawings include fabrication, layout, setting, installation, coordination and similar drawings and diagrams, and include performance data associated therewith, including weights, capacities, speeds, outputs, consumption, efficiencies, voltages, amperages, cycles, phases, noise levels, operating ranges and similar information.
- B. Samples: Units of typical work, materials or equipment items, showing the workmanship, pattern, trim and similar qualities proposed for the work to be provided, as designated.
- C. Manufacturer's Data: Product manufacturer's standard printed product information, including promotional brochures, product specifications, installation instructions and diagrams, statements of compliance with standard performance charts or curves, and similar information concerning the standard portions of the manufacturer's products.
- D. Test Reports: Specific reports prepared by independent testing laboratories and others, showing the results of specified testing on either the material/equipment provided or on identical material/equipment, and on installed electrical systems.
- E. Industry Standards: Printed copies of the current standards recognized in the industry. Current means the latest issue as of the date of these specifications, unless otherwise indicated; within the

text of these specifications the date-suffix frequently shown with identification numbers has been omitted.

- F. **Manufacturer's Product Warranties:** Manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the Manufacturer, when and if the product fails within certain operational conditions and time limits.
- G. **Operating Instructions:** The written instructions by the manufacturers, fabricators, or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation, control and shut-down of each operating item of the equipment and each electrical system.
- H. **Maintenance Manuals:** The compiled information provided for the Owner that certain acts of restitution will be performed when and if certain portions of electrical work fail within certain operational conditions and time limits.
- I. **Final Inspection:** At the final inspection, the fire sprinkler contractor should have for review and closeout documentation all pertinent NFPA paperwork properly filled out on NFPA forms as applicable (NFPA 13, 14, 20, 24). The shop drawing approval letter from this office should be available. A set of as-built fire sprinkler shop drawings and hydraulic calculations shall be placed in a white PVC tube marked 'Fire Sprinkler Shop Drawings' and securely fixed in the fire sprinkler riser room.

1.3 SUBMITTAL FORM AND PROCEDURES:

- A. **General:** Comply with Division 1 requirements for identification, quantities processing, scheduling and similar general requirements, except as otherwise indicated. Submittals shall be complete, in one package, clearly identified and cross-referenced to the appropriate specification section defining the submitted item. Partial submissions will not be addressed. The Contractor is responsible for any delays caused by incomplete submittal packages.
- B. **Quantities:** Provide quantities as listed in the General Conditions or as otherwise indicated in the Division 21 Specifications.
- C. **Presentation:** Submittals shall be assembled in three ringed binders with each specification section separated by a tab on which the specification section is noted. The submittals shall be clearly marked indicating which specific item is being considered and all its related information. Submittals not complying with these requirements are subject to being returned without being reviewed.
- D. **Should Contractor desire to substitute another manufacturer's equipment for one specified by name,** the contractor shall apply in writing at least ten (10) days prior to bid date for such permission. He shall provide supporting data and samples for Engineers consideration. No substitution shall be made for any material, article, or process required under the contract unless approved by the Engineer.
- E. **Any time that is required by the Engineer for a request to review submittals for substitute equipment after the award of bids will be billed to the contractor at the Engineer's current hourly billing rate.** The Engineer's review time will be billed to the contractor whether the proposed substitution is accepted or rejected.

- F. Operating Instructions: The written instructions by the manufacturer, fabricator, or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation.
- G. Response to Submittals: Where standard product data have been submitted in fulfillment of project requirements, it is recognized that the submitter has already determined that the products fulfill the specified requirements, and that the submittals are for the Architects' or Engineers' information only, but will be returned without action where observed to be non-complying with the requirements. Where uniquely prepared information is submitted, it is recognized to represent the preparer's interpretation or solution to the specified requirements, subject to the Architects', or Engineers' concurrence and appropriate action as indicated in Division 01.
- H. Shop Drawings and Samples: After checking and verifying all field measurements, the Contractor shall submit to the Engineer for review, in accordance with the accepted schedule of shop drawings submissions, copies of all shop drawings, which shall have been checked by and stamped with the approval of the Contractor and identified as the Engineer may require. The data shown on the shop drawings shall be complete with respect to dimensions, design criteria, materials of construction and the like to enable the Engineer to review the information as required.
- I. The Contractor shall also submit to the Engineer for review, with such promptness as to cause no delay in work, all samples required by the Contract Documents. All samples shall have been checked by and stamped with the approval of the Contractor, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which intended.
- J. At the time of each submission, the Contractor shall in writing call the Engineer's attention to any deviations that the shop drawings or sample may have from the requirements of the Contract Documents.
- K. No work requiring a shop drawing or sample submission shall be commenced until the submission has been reviewed by the Engineer. A copy of each shop drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer.
- L. The Engineer's review of shop drawings or samples shall not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has in writing called the Engineer's attention to such deviation at the time of submission and the Engineer has given written approval to the specific deviation, nor shall any review by the Engineer relieve the Contractor from responsibility for errors or omissions in the shop drawings.
- M. The Contractor's shop drawing stamp shall indicate that the shop drawings have been checked for conformity to the Contract Documents and appropriate means have been taken to insure that the material and /or equipment will fit into the space available. Shop drawings will be returned without review if the submittals do not have the Contractor's stamp or the submittals have not been reviewed by the Contractor.
- N. The Engineer's review of shop drawings is for general conformance with design concept only. The Contractor is responsible for all quantities, dimensions and coordination of the work of all trades. Corrections or comments made on the shop drawing during this review do not relieve the

contractor from compliance with requirements of the contract documents. The Contractor is responsible for selecting fabrication processes and techniques of construction and for performing all work in a safe and satisfactory manner.

- O. The Contractor shall stamp the shop drawings and submittals and verify by his/her signature that the shop drawings and submittals have been checked for compliance with the contract documents.
- P. The Contractor shall provide TABLE A as a cover letter with the submittals. The "Date Submitted" column shall be filled in by the Contractor. The remaining three columns are for the Engineer's use.

1.4 GENERAL SUBMITTAL REQUIREMENTS:

- A. Applicability: Wherever it is indicated that a shop drawing, sample, manufacturer's brochure, certification, test, copy of standard operating instruction, manual, extra stock, guarantee or warranty is required, the appropriate submittal is required regardless of whether it is specified as a "submittal"; the Architects' or Engineers' decision shall be final. , Include SCO ID number on all submittals including hydraulic calculations and product data.

1.5 SUBSTITUTIONS:

- A. Refer to the General Conditions for the requirements relative to substitutions.
- B. Substitutions: Fire Protection submittals are not opportunities for gaining acceptance of substitutions. Where three or more manufacturers are specified by name, or by catalog reference, Contractor shall select for use any of those so specified.
- C. Should Contractor desire to substitute another manufacturer's equipment for one specified by name, the contractor shall apply in writing at least ten (10) days prior to bid date for such permission. He shall provide supporting data and samples for Engineers consideration. No substitution shall be made for any material, article, or process required under the contract unless approved by the Engineer.
- D. Any time that is required by the Engineer for a request to review submittals for substitute equipment after the award of bids will be billed to the contractor at the Engineers current hourly billing rate. The Engineers review time will be billed to the contractor whether the proposed substitution is accepted or rejected.

1.6 OPERATION AND MAINTENANCE MANUALS

- A. Submit two (2) sets of 8-1/2" x 11" text as well as full-size drawings sixty (60) days prior to operator training/pre-final inspection bound in three D side ring capacity expansion binders with durable plastic covers for review by the Professional.
- B. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

- D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, typed or printed on thirty (30) pound white paper.
1. Part 1: Directory, listing names, addresses, and telephone numbers of Professional, Contractor, Subcontractors, and equipment suppliers.
 2. Part 2: Operation and maintenance instructions arranged by system or process flow and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a) Significant design criteria.
 - b) List of equipment.
 - c) Parts list for each component.
 - d) Maintenance instructions for equipment and systems.
 - e) Maintenance instructions for finishes, including recommended cleaning methods and materials and Operating instructions.
 - f) Special precautions identifying detrimental agents.
 - g) Special Requirements of other sections of this specification noted to be included in the operating and maintenance manual.
 3. Part 3: Project documents and certificates, including the following:
 - a) All approved Submittals
 - b) Certificates of Compliance
 - c) Photocopies of warranties and bonds
 - d) Material safety data sheets
- E. Submit five (5) copies of completed volumes in final form fifteen (15) days prior to owner training. These copies will include Professional's previous review comments.
- F. Submit eight final volumes revised, within ten (10) days after pre-final observation.

PART 2 PRODUCTS

This Part Not Used

PART 3 EXECUTION

This Part Not Used

END OF SECTION 210502

TABLE A - Shop Drawings Required

Shop Drawings and Submittals Required for this Project	Date Submitted by Contractor	Date Received by Engineer	Date Returned by Engineer	Status
21 05 01 – Common Work for Fire Suppression				
21 05 13 – Electrical Work for Fire Protection				
21 05 53 – Identification				
21 11 01 – Fire Protection Piping and Fittings				
21 11 02 – Valves for Fire Protection				
21 11 04 – Hangers and Supports				
21 13 16 – Dry Pipe Sprinkler Systems				
21 23 13 – Wet Pipe Sprinkler Systems				
21 30 01 – Fire Pumps				

I have reviewed the shop drawings and submittals listed above for compliance with the contract documents.

Contractor's Signature

SECTION 210503 – COMMON ELECTRICAL REQUIREMENTS FOR FIRE PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. Section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- C. Related Sections:
 - 1. All Specification Sections relate to the specification herein.

1.2 REFERENCES

- A. Refer to Section 210501 for complete listing of references.

1.3 SUBMITTALS

- A. Section 210502 – Fire Protection Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.
- C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years experience.
- B. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three (3) years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
- D. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.1 WIRING

- A. All wiring and conduit shall be in accordance with the requirements of Division 26.
- B. Low voltage control wiring shall be not less than #18 gauge copper wire run in metallic conduit.
- C. All control wiring under 30 Volts shall be considered low voltage wiring regardless of Class.

2.2 MOTORS

- A. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with standards of ASA-C50 and conform thereto for insulation resistance and dielectric strength. Motors shall be provided with conduit terminal box, adequate starting and protective equipment as specified or required. Size shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and at least shall be the horsepower indicated or specified. Motors shall be selected for quiet operation.
- B. Motors less than 3/4-HP shall be single phase, PSC/capacitor start-induction run, open type, splash proof. Motors 3/4-HP and larger shall be induction, open 3-phase multi tap unless otherwise indicated. Voltage for 3-phase motors is noted in schedules. Coordinate electrical service requirements with Electrical Contractor.
- C. Motors shall be provided with overload protection. On 3-phase motors overload protection shall be in the starters. Single-phase motors shall have built-in thermal overload protection.
- D. Motors shall be sufficient size for the duty to be performed, not less than that indicated on the drawings, and shall not exceed their full rated load when the driven equipment is operating at specified capacity under the most severe conditions likely to be encountered. All motors shall be for continuous duty classification based on 40 degrees C ambient temperature unless otherwise indicated.
- E. Motors shall be rated "energy efficient" based on NEMA Table 12-6C. Efficiency shall be determined in accordance with IEEE Standard 112, method B.
- F. Motor efficiency shall comply with North Carolina State Building Code – Electrical – latest approved edition.
- G. All vertically mounted motors shall be provided with thrust bearings.
- H. Motors shall be open drip proof (ODP) for indoor use where satisfactorily housed, guarded drip proof when exposed to contact by employees or building occupants, TEFC (totally enclosed fan cooled) for outdoor use.
- I. Motors that are specified to cycle on and off automatically under control of a device shall be capable of making starts as frequently as the device may demand. Other motors shall be capable of being started 4 times per hour without damage.
- J. All 3-phase motors shall be provided with lugs.
- K. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque. Class "B" insulation shall be provided.
 - 1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.

2. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
3. Service Factor: The service factor shall be at least 1.15 for poly phase motors and 1.35 for single phase motors.

L. All motors 40 hp and larger shall be provided with reduced voltage starters.

2.3 STARTERS AND CONTROLLERS

A. Controllers and Control: Where controllers and controls are specified to be provided by the Contractor, they shall conform to the requirements specified below:

1. Controllers shall conform to adopted standards and recommended practices of the Industrial Control Standards of National Electrical Manufacturer's Association and the standard for Industrial Control Equipment of the Underwriters' Laboratories, Inc. Motors 93 W (1/8-HP) or larger and shall be provided with thermal overload protection. Manually reset type. Overload protective device shall be provided, mounted in separate enclosure. Single or double-pole tumbler heavy duty switches may be used as manual controllers for motors of 186 W (1/4-HP) or less in rating. Manual controllers for motors larger than 186 W (1/4-HP) shall be designed for purpose and shall have horsepower rating adequate for motor. Two speed motors shall have two (2) winding type controllers unless otherwise specified.
2. Combination magnetic starter shall be full voltage, across the line type with under-voltage release for manual or automatic operation and shall break all phases on 3-phase starters for motors up to 40-HP. Starters shall be provided with start-stop pushbuttons mounted on cover unless controlled by hand-off-automatic (HOA) device. Hand-off-automatic device shall not be wired to override safety device interlocks on starter and shall be mounted on the starter or if adjacent mounted remotely, provide test start pushbutton on starter. All auxiliary contacts required for interlocking purposes shall be furnished and installed by the Contractor furnishing the starter. All starters not included in motor control centers shall be provided by Division 21.
3. Manual starters shall be provided with a manually operated trip free switch, horsepower rated with a separate fused disconnect.
4. Contractor providing the starters shall be responsible for all motors to be protected with proper size heater or thermal elements. All starters and enclosures shall be NEMA Standard, Type 1 unless otherwise specified. In wet locations, enclosures shall be NEMA 3R.
5. All starters and pushbutton stations shall be provided with labels as specified under identification designating service for which starter is used. Plate shall be firmly attached to starter or wall mounted adjacent to the starter.
6. All cabinets provided for the installation of motor starters, control transformers, relays, and appurtenant items shall be provided with gravity or forced ventilation at the option of the manufacturer. Openings shall be placed at bottom and top of the cabinet or high-low in the door if recessed and of sufficient size to limit the temperature rise through the enclosure or ambient compensated heater elements shall be provided.

7. All controllers and starters shall be rated for the same voltage as the motor which it serves. If the voltage is not indicated on the Fire Protection drawings, the Contractor shall provide the units at the voltage listed on the electrical drawings.
8. Provide built-in 120-volt control circuit transformer, fused from line side, where service voltage exceeds 240 volts.
9. Provide externally operated manual reset.
10. Motor connections shall be in waterproofed, sealtite flexible conduit, maximum length of 18", except where plug-in electrical cords are specifically indicated.

2.4 DRIVES

- A. Machinery drives shall be provided for all power driven equipment specified in this Division.
- B. Drives shall be V-belt and shall be selected to overcome the starting inertia of the equipment without slippage but in no case rated for less than 150% of the full motor load. Drives which require two (2) belts or less shall be adjustable. Drives which require three (3) or more belts shall be fixed sheave unless noted otherwise. Contractor shall provide an initial drive package sized for specified conditions and shall include in his proposal the cost of an additional pulley and belt for each fixed sheave drive. |
- C. Adjustable type sheaves, shall be selected such that the scheduled speed of the driven equipment is near the midpoint in the adjustment range of the sheave.
- D. Fixed type sheaves shall be changed in size once during the balancing period if necessary to achieve proper air quantities.
- E. Sheaves shall be machined cast iron.

2.5 SOURCE QUALITY CONTROL

- A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned motors
- B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing motors to remain or are to be reinstalled.

3.2 INSTALLATION

- A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- B. Install engraved plastic nameplates in accordance with Division 26.
- C. Ground and bond motors in accordance with Division 26.

3.3 WIRING

- A. Regardless of voltage, furnish and install all control and instrumentation wiring, all interlock wiring and equipment control wiring for the equipment furnished.
- B. Electrical Contractor will furnish and install all wiring except as noted below.
 - 1. Electrical Contractor will furnish and install all power wiring complete from power source to the disconnect.
 - 2. The Fire Protection Contractor will furnish and install all disconnects and starters not factory mounted on equipment and not located in motor control centers.
 - 3. The Fire Protection Contractor shall wire from the disconnect to the motor.
 - 4. When not provided under Division 26, controllers and controls shall be provided by the Fire Protection Contractor.
- C. Check with Electrical Contractor on service outlets provided to determine that service, circuit protection, switches and wiring provided are of adequate size to meet Code requirements for equipment provided. Discrepancies shall be brought to the attention of the Engineer before work is installed. Cost for changes not so noted shall be at the expense of this Contractor. Electrical cost increase due to equipment substitution of different electrical characteristics shall be this Contractor's expense.
- D. Provide necessary electrical data for all equipment to the Electrical Contractor for proper coordination.
- E. Control and interlock wiring shall be run in conduit.
- F. Provide control circuit disconnect for all motor starters as required by Section 430-74 of NEC.
- G. Unless otherwise noted or specified, all low voltage and line voltage control and instrumentation wiring and devices for equipment furnished under Division 21 shall be provided as part of this Division 21. Control wiring is considered to be the portion of the wiring which carries the electric signal directing or indicating the performance of a starter, relay, or contactor generally installed between starters, indicators, and remote control devices.
- H. Examine the drawings, and in cooperation with the Electrical Trade, confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping to be no closer than 24-inches from the vertical line to electric motor controllers, switchboards, panel boards, or similar equipment. If the vertical line is less than 24-inches, the installation of piping shall be relocated.

3.4 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements; Division 01 - 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 7.15.

END OF SECTION 210503

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SECTION 210553 – IDENTIFICATION FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. Section includes:
 - 1. Nameplates.
 - 2. Valve Tags.
 - 3. Warning Tags.
 - 4. Stencils.
 - 5. Pipe markers.
 - 6. Ceiling markers.
- C. Related Sections:
 - 1. Division 09 - Painting and Coating: Execution requirements for painting specified by this section.

1.2 REFERENCES

- A. Refer to Section 210501 for complete listing of references.

1.3 SUBMITTALS

- A. Section 210502 – Fire Protection Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 GENERAL

- A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Safety Sign Co.
 - 3. Seton Identification Products
 - 4. Brady Worldwide

2.2 EQUIPMENT NAMEPLATES

- A. Product Description:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Red.
 - 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 2½ by ¾-inch.
 - 6. Minimum Letter Size: ¼-inch for name of units if viewing distance is less than 24-inches, ½-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.

2.3 VALVE TAGS

- A. Plastic Tags:
 - 1. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1½-inches diameter.
 - 2. Fasteners: Brass beaded chain.

B. Metal Tags:

1. Brass, Aluminum or Stainless Steel with stamped letters; tag size minimum 1½-inches diameter or square with finished edges and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain.

2.4 WARNING TAGS

A. Information Tags:

1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3¼ x 5-5/8-inches with grommet and self-locking nylon ties.

2.5 STENCILS

A. Stencils: With clean, die-cut symbols and letters of following size:

1. Up to 2-inches Outside Diameter of Insulation or Pipe: ½-inch high letters.
2. 2½ to 6-inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
3. Over 6-inches Outside Diameter of Insulation or Pipe: 1¾-inches high letters.
4. Equipment: 1¾-inches high letters.
5. Stencil Paint: As specified in Division 09, semi-gloss enamel, colors and lettering size, conforming to ASME A13.1.

2.6 SCHEDULES

A. Typewritten letter size list of applied labels, tags and location in anodized aluminum frame.

1. Equipment Nameplate Schedule: For each item of equipment to be labeled, on 8½ by 11-inch bond paper. Tabulate equipment identification number(s) and identify where equipment is located, plus the Specification Section number and title where equipment is specified.
 - a) Equipment schedule shall be included in operation and maintenance data.
2. Valve Tag Schedules: For each piping system, on 8½ 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.
 - a) Valve-tag schedule shall be included in operation and maintenance data.

2.7 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

1. Preprinted, color-coded, with lettering indicating service, and showing flow direction.
2. 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.
3. Lettering Size: At least 1½-inches high.

B. Plastic Pipe Markers:

1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:

1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Underground Pipe Markers:

1. Metal pipe: Bright colored continuously printed plastic ribbon tape, minimum 6-inches wide by 4-mil thick, manufactured for direct burial service.
2. Plastic pipe: Bright colored, continuously printed, minimum 4-mil thick, solid aluminum foil core, manufactured for direct burial service and detectable with non-ferrous metal detector.
3. Size per burial depth:
 - a) 2-inch wide tape for up to 14-inch deep burial.
 - b) 3-inch wide tape for 14 to 24-inch deep burial.
 - c) 6-inch wide tape for 24 to 36-inch deep burial

2.8 CEILING MARKERS

A. Description: Laminated three-layer plastic with 1/8-inch minimum engraved black letters on white background or color matching lay-in ceiling grid.

1. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
2. Match description used on Equipment Label or Valve Tag

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners.
- C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- D. Install tags using corrosion resistant chain. Number tags consecutively by location.
- E. Install underground plastic pipe marker tape below finished grade, directly above buried pipe. Install detectable utility marking tape above all non-metallic, outside pipelines.
- F. Identify fire pumps and tanks with plastic nameplates. Identify in-line pumps and other small devices with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves with tags.

1. In buildings where existing piping systems are modified, the new valve tag numbers and list shall be coordinated with existing valve tag numbers and lists; and, those supplied under other contracts, if applicable.

I. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Identify service, flow direction, and pressure (where applicable). Install in clear view and align with axis of piping.

1. On straight runs of piping at intervals not exceeding 20-feet

2. Within 2-feet of all elbows

3. Within 2-feet of all piping as it passes through partitions (markers provided on both sides of partitions)

4. Provide ceiling markers to locate valves and equipment above ceilings. Locate on ceiling or grid closest to valve or equipment location.

END OF SECTION 210553

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SECTION 211101 – FIRE PROTECTION PIPING

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. Fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- C. All piping material shall be manufactured in the USA.

1.2 SECTION INCLUDES

- A. Work in this Section includes the following:
 - 1. Automatic sprinkler system piping.
 - 2. Fire Pump system piping.

1.3 RELATED SECTIONS

- A. All sections of the Project Manual apply to this section.

1.4 REFERENCES

- A. Refer to Section 210501 for complete listing of references.

1.5 SUBMITTALS

- A. Section 210502 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Requirements for submittals.
- B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. The Contractor shall submit manufacturer's catalog data for the following:
 - 1. Automatic sprinkler system piping.

PART 2 PRODUCTS

2.1 FIRE PROTECTION SYSTEM PIPING

- A. Aboveground
 - 1. Steel Pipe: ASTM A53, ASTM A795, Schedule 10 and 40 black.

- a) Steel Fittings: ASME B16.9, wrought steel, butt-welded, ASME B16.25, butt-weld ends, ASTM A234, wrought carbon steel and alloy steel, ASME B16.5, steel flanges and fittings; ASME B16.11, forged steel socket welded and threaded.
 - (i) Schedule 40 rolled grooved or threaded standard steel for branches and laterals 2" and below.
 - (ii) Schedule 10 rolled grooved standard steel for mains 2-1/2" and above.
 - (iii) Steel piping servicing the pre-action system shall be internally galvanized per NFPA 13 requirements.
 - b) Cast Iron Fittings: ASME B16.1, flanges, and flanged fittings, ASME B16.4, threaded fittings.
 - c) Malleable Iron Fittings: ASME B16.3, threaded fittings ASTM A47.
 - d) Mechanical Grooved Couplings: Ductile iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - (i) Rigid Type: Housings shall be cast with bolt pad to provide system rigidity and support and hanging in accordance with NFPA 13.
 1. 1-1/4" – 4": Rigid coupling designed for direct installation onto grooved end pipe without prior field disassembly.
 2. 5" and Larger: Standard rigid coupling.
 - (ii) Flexible Type: Use in seismic areas where required by NFPA 13.
 - e) Mechanical Grooved Fittings: ASTM A536 ductile iron and ASTM A53 steel fittings with grooved ends designed to accept couplings.
 - f) All fire main piping shall be joined by flanges. Refer to the contract drawings.
2. Flexible stainless-steel hose connections between sprinkler heads and branch piping is prohibited.
 3. Press-fit sprinkler piping or threaded thin wall is prohibited.

PART 3 EXECUTION

3.1 GENERAL

- A. All materials, equipment and accessories specified in this section shall be installed in strict accordance with NFPA 13 and North Carolina Department of Insurance and the manufacturer's recommendations.

3.2 PIPING INSTALLATION

A. General

1. All piping in finished areas shall be run concealed. The Contractor shall furr in piping or provide soffiting as required and in accordance with the Professional's instructions. All piping

- shall be installed as required to suit space available in building structure, above suspended ceilings, and other locations found necessary for installation. Install piping as high as possible.
2. The Contractor shall not install any piping that will interfere with any lights, openings, doors, windows, ductwork, equipment, and existing or special conditions. Headroom in front of openings, doors, or windows shall not be less than the top of the opening. Provide all piping offsets necessary to avoid interference with other work. Piping offsets shall include all devices and assemblies necessary to accommodate the change in direction of the piping.
 3. All piping shall run straight with no more couplings and joints than necessary, shall be grouped wherever practical and shall be carefully installed to provide for proper alignment slope and expansion.
 4. Pipes carrying fluids shall not be installed in transformer vaults, electrical equipment rooms, elevator hoist ways, elevator equipment rooms, or similar areas having a collection of electrical equipment. Pipes shall not be installed over, around, in front of, in back of, or directly below, electrical controls, panels, switches, terminals, boxes, or similar electrical equipment.
 5. All piping shall be installed with not less than 2-inches between finish covering of pipe and all other work or piping.
 6. Reduction in sizes of pipes shall be made with reducing fittings. Bushings will not be permitted.
 7. Bullhead connections in any piping service are prohibited.
 8. All screwed joints shall be made with a non-corrosive, non-hardening compound or Teflon tape applied on the male thread only. All compounds must be approved for the pipe on which they are used. Pipe ends shall be reamed or filed out to size of bore and all chips and cuttings removed. Ends of pipe must be cut square so as to seat in the bottom of the recess in drainage fittings. In making joints in chromium plated brass pipe no more than one thread shall remain exposed when joint is completed. Caulking of screwed joints is not permitted. Pipe joint cement and paint will be permitted only on external threads.
 9. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the coupling manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.3 PROTECTION AGAINST PHYSICAL DAMAGE

- A. In concealed locations, where piping, other than cast-iron or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1¼-inches from the nearest edge of the member, shield plates shall protect the pipe. Protective shield plates shall be a minimum of 1/16-inch thick steel, shall cover the area of the pipe where the member is notched or bored and shall extend a minimum of 2-inches above sole plates and below top plates.

END OF SECTION 211101

SECTION 211102 – GENERAL DUTY VALVES FOR FIRE PROTECTION PIPING

PART 1 GENERAL

1.1 GENERAL

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Gate valves.
 - 2. Ball valves.
 - 3. Butterfly valves.
 - 4. Check valves.
 - 5. Reduced Pressure Backflow Preventer
- B. Related Sections:
 - 1. Division 21 Sections

1.3 REFERENCES

- A. Refer to Section 210501 for complete listing of references.

1.4 SUBMITTALS

- A. Section 210502 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Requirements for submittals.
- B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of all valves.
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with the Authority Having Jurisdiction published requirements and standards.
- B. Maintain one (1) copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum (three) 3-years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum (three) 3-years documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum (one) 1-week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting 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.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install valves underground when bedding is wet or frozen.

1.11 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish (two) 2 packing kits for each size valve.

PART 2 PRODUCTS

2.1 LISTED FIRE PROTECTION VALVES

- A. All valves shall be products regularly produced for the specified service and rating in accordance with the manufacturer's catalog or engineering data. All valves shall be marked with the manufacturer's name or trademark. The recommended service pressure and the size, by letters and figures, cast or stamped on the body of the valve.
- B. All valves shall be UL listed and FM approved for the intended service. All valves shall be permanently marked.
- C. All valves shall be standard 200 pounds per square inch (psi) WOG minimum. Valve ends shall be compatible with the piping system served.
- D. Composition disks shall be as recommended by the valve manufacturer for fire protection water service.
- E. Gate valves shall be iron body, bronze mounted, tapered seat, OS&Y type, O ring packing. AWWA C500, 200 psi working pressure. Open counterclockwise. Valves shall be of a design that

requires no more than fifty (50) pounds pull on the standard valve wrench to provide positive shutoff against rated working pressure.

- F. All flanges shall be flat faced, smooth finished and shall conform in dimensions and drilling to the American Cast Iron Flange Standard Class 125 (B16.1 48).
- G. Ring gaskets 1/16 inch thick shall be used with all flanged valves. Gaskets shall be Cranite, Garlock. Paint one (1) side of gasket with graphite and oil, or accepted substitution, thread lubricant before installing.
- H. Manufacturers:
 - 1. AFAC Inc.
 - 2. Central Sprinkler Corp.
 - 3. Conbraco Industries, Inc.; Apollo Valve
 - 4. Crane Valve, North America
 - 5. Grinnell Fire Protection
 - 6. Hammond Valve
 - 7. McWane, Inc.; Kennedy Valve Div.
 - 8. Milwaukee Valve Company
 - 9. Mueller Company
 - 10. NIBCO, Inc.
 - 11. Potter-Roemer, Fire Protection Div.
 - 12. Reliable Automatic Sprinkler Co., Inc.
 - 13. Stockham Valves & Fittings
 - 14. Victaulic Co. of America
 - 15. Watts Industries, Inc.; Water Products Div.

2.2 GATE VALVES WITH WALL INDICATOR POSTS

- A. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, non-rising stem, operating nut, and flanged ends.
- B. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with operating wrench, extension rod, locking device, and cast-iron barrel.

2.3 GATE VALVES – OS&Y TYPE

- A. Comply with UL 262
- B. 2-inches and smaller: Bronze gate, union bonnet, OS&Y type, rising stem, solid wedge disk, threaded ends, UL listed and FM approved.
 - 1. Milwaukee 149

2. Stockham B133

3. Nibco

C. 2½-inches and larger: Iron body bronze mounted OS&Y, solid wedge disk, flanged ends, UL listed and FM approved.

1. Mueller A-2073-6

2. Stockham G-634

3. Nibco

2.4 BALL VALVES

A. Comply with UL 1091, except with ball instead of disc.

B. 2½-inches and Smaller: 400 psi WOG, full port, two piece, bronze body, chrome plated steel ball and stem, UL listed and FM approved.

1. Nibco KT-580 Series

2. Stockham US214 Series, threaded ends.

3. Mueller

2.5 BUTTERFLY VALVES

A. Comply with UL 1091

B. 2½-inches and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.

2.6 CHECK VALVES

A. Comply with UL 312

B. 2-inches and larger: Swing type, cast-iron body with flanged or grooved ends.

2.7 REDUCED PRESSURE BACKFLOW PREVENTER

A. The assembly shall consist of a main line valve body composed of two (2) independently acting approved clapper style check modules with replaceable seats and disc rubbers. Servicing of both check modules does not require any special tools and are accessed through independent top entry covers. This assembly shall be fitted with approved UL/FM inlet/outlet resilient seated shutoff valves and contain four (4) properly located resilient seated test cocks as specified by AWWA Standard C511. The auxiliary bypass line contains a 5/8" x 3/4" Water Meter that complies with ANSI/AWWA Standard C700 coupled with an approved check assembly compliant to AWWA Standard C511. The bypass line is designed to detect leaks or unauthorized water usage of the water system while protecting against possible backpressure and backsiphonage conditions for high hazard (i.e., toxic) applications. The valve body shall utilize a coating system with built in electrochemical corrosion inhibitor and microbial inhibitor. Flow and pressure loss performance parameters shall meet the requirements of AWWA Standard C511.

B. 6" Backflow Preventer.

1. AMES
2. FEBCO
3. WATTS

2.8 INDICATING VALVES

- A. Comply with UL 1091, with integral indicating device and ends matching connecting piping.
 1. Indicator: Electrical, 115-V AC, prewired, 2-circuit, supervisory switch.
- B. 2-inches and Smaller: Ball or butterfly valve with bronze body and threaded ends.
- C. 2½-inches and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

2.9 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves 2-inches and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves 2-inches and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves 2-inches and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves 2-inches and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.10 HOSE VALVES

- A. Comply with UL 668
- B. Brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include angle or gate pattern design;
- C. Female 2½-inch inlet and male hose outlet; and lugged cap, gasket, and chain.
- D. Hose valve threads according to NFPA 1963 and matching local fire department threads.
 1. Valve Operation: Non-adjustable type, unless pressure-regulating type is indicated.
- E. Finish: Rough chrome-plated, plain brass or bronze finish.

2.11 AUTOMATIC DRAIN VALVES

- A. Comply with UL 1726
- B. ¾-inch, ball-check device with threaded ends.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.

- B. Verify piping system is ready for valve installation.
 - 1. 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.
 - 2. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
 - 3. Examine threads on valve and mating pipe for form and cleanliness.
 - 4. 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.
 - 5. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install valves with stems upright or horizontal, not inverted.
- D. Install valves in position to allow full stem movement.
- E. Install ¾-inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- F. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- G. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Division 08.
- H. Install check valves for proper direction of flow in horizontal position with hinge pin level.
- I. Revise check valve installation requirements to suit Project; delete those not required.
- J. Refer to Section 211104 for pipe hangers.
- K. Refer to Section 211101 for piping materials applying to various system types.

3.3 HOSE STATION INSTALLATION

- A. Install freestanding hose stations for access and minimum passage restriction.
- B. Install NPS 2½ hose valves with connections, unless otherwise indicated.
- C. Install freestanding hose stations with support or bracket attached to pipe and substrate.

- D. Install wall-mounting valves in cabinets. Include pipe escutcheons with finish matching valves inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose.

3.4 VALVE APPLICATIONS

- A. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section or as required.
- B. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install globe valves for throttling, bypass, or manual flow control services.
- D. Install check valves on the outlet of the fire department connection.
- E. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

3.5 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service.
- B. Replace valves if persistent leaking occurs.

END OF SECTION 211102

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SECTION 211104 – HANGERS AND SUPPORTS FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.

1.2 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Sleeves.
6. Mechanical sleeve seals.
7. Formed steel channel.
8. Firestopping relating to fire protection work.
9. Firestopping accessories.
10. Equipment bases and supports.

B. Related Sections:

1. Division 03 - Concrete Forming and Accessories
2. Division 03 - Cast-In-Place Concrete
3. Division 07 – Fire-stopping
4. Division 07 - Joint Protection.
5. Division 09 - Painting and Coating
6. Section 210501 - Common Work Results for Fire
7. Section 211101 – Fire Protection Piping
8. Division 07: Installation requirements for roof flashing installation.

1.3 REFERENCES

- A. Refer to Section 210501 for complete listing of references.

1.4 DEFINITIONS

- A. Fire-stopping (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.

1.5 SYSTEM DESCRIPTION

- A. Fire-stopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479, to achieve fire ratings of adjacent construction in accordance with FM or UL requirements.
- B. Surface Burning: ASTM E84 UL 723 with maximum flame spread / smoke developed rating of 25/50.
- C. Fire-stop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

- A. Fire-stopping: Conform to applicable code (FM or UL) for fire resistance ratings and surface burning characteristics.
- B. Fire-stopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.7 SUBMITTALS

- A. Section 210502 – Fire Protection Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Shop Drawings:
 - 1. Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers, metal framing systems, pipe stands and/or equipment supports.
 - 2. Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Fire-stopping: Submit data on product characteristics, performance and limitation criteria.
- D. Fire-stopping 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. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- F. Welding certificates.
- 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.

1.8 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.
- B. Through Penetration Fire-stopping 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 minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- G. Perform Work in accordance with State, Federal and local standards approved by the Authority Having Jurisdiction.
- H. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with a minimum three years experience.

1.10 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- 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 damage, by storing in original packaging.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply fire-stopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3-days after installation of fire-stopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.13 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.14 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Install in accordance with NFPA 13 for sprinkler systems.
- B. Install hangers to with minimum ½-inch space between finished covering and adjacent work.
- C. Where hanger rods are longer than 18-inches, provide lateral bracing at every fourth hanger. Do not support piping by wire, rope wood or other makeshift device. Provide additional steel supports where building construction does not permit the hanger spacing as specified in the schedules. Location and details shall be submitted to the Professional for review.
- D. Roller type supports shall be used for pipes subject to axial movement. Brace so movement occurs in roller rather than support rod.
- E. Where loading exceeds the safe allowable limit for any single insert, then multiple inserts shall be installed spaced no less than 12-inches on centers. The multiple inserts shall be connected with suitable size steel angles and locking bolts.
- F. Place hangers within 12-inches of each horizontal elbow.
- G. Use hangers with 1½-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

- H. Where fastenings are required in steel stud, wire lath or other non-masonry construction, a "J" hook and holding lock washer and nut shall be used which shall fasten to the opposite stud edge to which the item will abut. If the location of the fastening is not a steel stud, a structural steel shape shall be fastened to the wall with bolt and holding nut, with the fastening extension through the wall. The use of toggle bolts will not be permitted.
- I. Prime coat exposed steel hangers and supports. Refer to Division 09 - Painting. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- J. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Division 09 - Painting.
- K. Do not penetrate building structural members unless indicated.
- L. The Contractor shall furnish and install all supports, hangers, inserts and fasteners for the items incidental to the work in the construction of the project. Supports and hangers shall be provided to suit specific conditions for the type of construction. The method adopted shall be subject to the approval of the Professional.
- M. Supports shall secure pipes in place, prevent swaying and vibration, maintain required grading, provide free expansion and shall have a neat appearance. Supports shall be selected for strength and service and installed in a manner, which will not stress building construction. A five (5) to one (1) safety factor relative to the gross weight of piping system including fluid shall be used in the selection of the supports. |
- N. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Only use inserts for suspending hangers from concrete slabs. Use beam clamps for suspending hangers from building steel. Do not hang one pipe from another. Do not use perforated band iron, wire or chain as hangers. Do not use vertical expansion shields. Do not hang from joist bridging.
- O. Fastenings installed in masonry walls shall be galvanized u-bolts set in the construction during erection.
- P. Steel frame Construction
 - 1. Support piping systems, devices, and equipment from structural steel members or secondary fabricated supports. Hanging from corrugated metal deck is prohibited.
 - 2. Where metal tabs integral with the metal deck are provided, support of piping, ductwork, devices and equipment from system to the maximum of the equivalent of a 10-foot length of 4- inch diameter, Schedule 40 section of pipe filled with water or 6-inch diameter cast iron drainage pipe. Where tabs projecting down from the metal deck system are not available, inserts for concrete deck construction shall be installed. Inserts in poured concrete slabs shall be iron, fabricated galvanized iron or steel of the type to receive a machine bolt head or nut after installation and shall permit adjustment of this bolt in one horizontal direction.
- Q. Reinforced Concrete Construction

1. Where concrete members support concrete roof or floor construction, support piping systems, devices, and equipment from roof to floor construction by use of concrete slab inserts.
2. Inserts in poured concrete slabs shall be iron or fabricated galvanized iron or steel of the type to receive a machine bolt head or nut after installation and shall permit adjustment of this bolt in one (1) horizontal direction. Inserts shall be accurately located before the concrete is poured.
3. Piping, tanks and equipment shall be adequately supported either by suspension from the construction above or by means of struts or brackets to the construction below or to the side.
4. Before drilling any concrete for attachments, installer shall carefully check concrete drawings and shop drawings and shall locate drilled holes to avoid reinforcing by at least 1 inch.
5. Hangers shall be installed in accordance with the HANGER AND ROD SCHEDULE.

HANGER AND ROD SCHEDULE

Nominal Pipe Diameter (Inches)	Steel Pipe Spacing (Feet)	Rod Size (Inches)	CPVC Pipe Spacing (Feet)	Rod Size (Inches)
1/2	5	3/8	5	3/8
3/4	6	3/8	5'-6"	3/8
1	7	3/8	6	3/8
1 ¼	8	3/8	6'-6"	3/8
1 ½	10	3/8	7	3/8
2	10	3/8	8	3/8
2 ½ and 3	10	1/2	9-10	3/8
4 and 5	10	5/8	NA	NA
6	10	3/4	NA	NA

8, 10, and 12	10	7/8	NA	NA
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HANGER AND ROD SCHEDULE NOTES:

Where unusual concentrated loads of valves and fittings occur, closer spacing shall be required. Submit specific cases for review and comment.

Where piping changes direction, supports shall be placed in each direction adjacent to joints and no more than 12-inches from the joint.

Piping larger than 16-inches shall be supported according to the details on the drawings.

- R. Where more than one piping system material is specified, install compatible system components and joints. Install flanges, union, and couplings at locations requiring servicing.
- S. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- T. All components of the hanger system shall UL listed and FM approved for use in fire protection systems.
- U. All hangers shall comply with the requirements of NFPA 13, The Standard for the Installation of Automatic Sprinkler Systems.
- V. Provide all steel required for support of pipes and equipment other than steel shown on Structural Engineer's drawings.
- W. All hanger materials including clevis hangers, rods, inserts, clamps, stanchions, brackets, shall have a factory applied finish of electro-plated zinc, unless noted otherwise.
- X. Hangers, clamps and supports for use on un-insulated copper piping shall be provided with inserts to isolate the copper piping from the hanger. Inserts shall be made of felt or plastic and shall be as manufactured by the hanger manufacturer.
- Y. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Carpenter & Paterson Inc.
 - 3. ERICO/Michigan Hanger Co.
 - 4. Globe Pipe Hanger Products Inc.
 - 5. Grinnell Corp.
 - 6. Tolco Inc.
 - 7. Unistrut Corp.; Tyco International, Ltd.
- Z. Hanger Materials:
 - 1. Horizontal Fire Protection Piping:

- a) 2-inch and smaller:
 - (i) B-Line B3100
 - (ii) Grinnell 260
 - (iii) PHD 450
 - b) 2-1/2 inch and larger:
 - (i) B-Line B3100
 - (ii) Grinnell 260
 - (iii) PHD 450
2. Vertical Piping (Riser Clamps):
- a) Steel Pipe:
 - (i) B-Line B3373
 - (ii) Grinnell 261
 - (iii) PHD 550
3. Connectors:
- a) Beam Clamps:
 - (i) B-Line B3033, B3050, B3291-B3297
 - (ii) Grinnell 88, 133, 134 or 292S.
 - (iii) PHD 360, 620
 - b) Concrete inserts:
 - (i) B-Line B2500, B3014
 - (ii) Grinnell 282, 285
 - (iii) PHD 950
 - c) Welded beam attachments:
 - (i) B-Line B3083
 - (ii) Grinnell 66
 - (iii) PHD 900
 - d) Piping adjacent to walls or steel columns, brackets:
 - (i) B-Line
 - (ii) Grinnell
 - (iii) PHD
 - e) Base supports:

- (i) B-Line
 - (ii) Grinnell
 - (iii) PHD
4. Hanger Rods:
- a) Hanger rod:
 - (i) B-Line
 - (ii) Grinnell
 - (iii) PHD
 - b) Continuous threaded rod:
 - (i) B-Line
 - (ii) Grinnell
 - (iii) PHD
 - c) Eye Rods:
 - (i) B-Line
 - (ii) Grinnell
 - (iii) PHD

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. 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.

2.4 FLASHING

- A. Metal Flashing: 26 gage thick galvanized steel.
- B. Metal Counter flashing: 22 gage thick galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq. ft sheet lead.
 - 2. Soundproofing: 1 lb./sq. ft sheet lead.
- D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Manufacturers:
 - a) Advance Products & Systems, Inc.
 - b) Calpico, Inc.
 - c) Metraflex Co.
 - d) Pipeline Seal and Insulator, Inc.
 - e) Thunderline/Link-Seal □
 2. Sealing Elements: Fire resistive silicone rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Carbon steel. 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.

2.6 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.
- E. Under-deck Clamp: Clamping ring with set screws.

2.7 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 and rough brass.
- D. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

PART 3 EXECUTION

3.1 GENERAL

- A. All materials, equipment and accessories specified in this section shall be installed in strict accordance with NFPA 13, North Carolina Department of Insurance and the manufacturers' recommendations.

3.2 EXAMINATION

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive fire-stopping.

3.3 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 materials to arrest liquid material leakage.
- D. Obtain permission from the Professional before using powder-actuated anchors.
- E. Do not drill or cut structural members.

3.4 INSTALLATION – INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4-inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.5 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. The Contractor shall furnish and install all supports, hangers, inserts and fasteners for the items incidental to the work in the construction of the project. Supports and hangers shall be provided to suit specific conditions for the type of construction. The method adopted shall be subject to the approval of the Professional.
- B. Supports shall secure pipes in place; prevent swaying and vibration; maintain required grading; provide free expansion and shall have a neat appearance. Supports shall be selected for strength and service and installed in a manner, which will not stress building construction. A five (5) to one (1) safety factor relative to the gross weight of piping system including fluid shall be used in the selection of the supports.
- C. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Only use inserts for suspending hangers from concrete slabs. Use beam clamps for suspending hangers from building steel. Do not hang one pipe from another. Do not use

perforated band iron, wire or chain as hangers. Do not use vertical expansion shields. Do not hang from joist bridging.

- D. Fastenings installed in masonry walls shall be galvanized u-bolts set in the construction during erection.
- E. All vertical piping shall be supported at each floor level. Riser clamps at exposed locations shall be of such design as to avoid creating a hazardous or unsightly condition and stay within space limitations. Pipe supports are required at the base of all vertical risers and shall be of riser size.
- F. Where hanger rods are longer than 18-inches, provide lateral bracing at every fourth hanger. Do not support piping by wire, rope wood or other makeshift device. Provide additional steel supports where building construction does not permit the hanger spacing as specified in the schedules. Location and details shall be submitted to the Professional for review.
- G. Where loading exceeds the safe allowable limit for any single insert, then multiple inserts shall be installed spaced no less than 12-inches on centers. The multiple inserts shall be connected with suitable size steel angles and locking bolts.
- H. Where fastenings are required in steel stud, wire lath or other non-masonry construction, a "J" hook and holding lock washer and nut shall be used which shall fasten to the opposite stud edge to which the item will abut. If the location of the fastening is not a steel stud, a structural steel shape shall be fastened to the wall with bolt and holding nut, with the fastening extension through the wall. The use of toggle bolts will not be permitted.
- I. Steel frame Construction
 - 1. Support piping systems, devices, and equipment from structural steel members or secondary fabricated supports. Hanging from corrugated metal deck is prohibited.
 - 2. Where metal tabs integral with the metal deck are provided, support of piping, ductwork, devices and equipment from system to the maximum of the equivalent of a 10-foot length of 4- inch diameter, Schedule 40 section of pipe filled with water or 6-inch diameter cast iron drainage pipe. Where tabs projecting down from the metal deck system are not available, inserts for concrete deck construction shall be installed. Inserts in poured concrete slabs shall be iron, fabricated galvanized iron or steel of the type to receive a machine bolt head or nut after installation and shall permit adjustment of this bolt in one horizontal direction.
- J. Reinforced Concrete Construction
 - 1. Where concrete members support concrete roof or floor construction, support piping systems, devices, and equipment from roof to floor construction by use of concrete slab inserts.
 - 2. Inserts in poured concrete slabs shall be iron or fabricated galvanized iron or steel of the type to receive a machine bolt head or nut after installation and shall permit adjustment of this bolt in one (1) horizontal direction. Inserts shall be accurately located before the concrete is poured.
 - 3. Piping shall be adequately supported either by suspension from the construction above or by means of struts or brackets to the construction below or to the side.

4. Before drilling any concrete for attachments, installer shall carefully check concrete drawings and shop drawings and shall locate drilled holes to avoid reinforcing by at least 1-inch.
5. Hangers shall be installed in accordance with the HANGER AND ROD SCHEDULE. (see SCHEDULES below)

3.6 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3½-inches thick and extending 6-inches beyond supported equipment. Refer to Division 03.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members, formed steel channel or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 210549.

3.7 INSTALLATION – FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.

3.8 INSTALLATION – SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1½-inches above finished floor level. Caulk sleeves. Extend sleeves through floors 3-inches above finished floor level in Kitchen or wet-areas.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with fire-stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel or stainless steel escutcheons at finished surfaces.

3.9 INSTALLATION – FIRE-STOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring fire-stopping.
- B. Apply primer where recommended by manufacturer for type of fire-stopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply fire-stopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- 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 fire-stopping 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 on both sides of building element.
 - b) Size sleeve allowing minimum of 1-inch 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.
- I. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof openings as follows:
 - a) Install sleeve through opening and extending beyond minimum of 1-inch on both sides of building element.
 - b) Size sleeve allowing minimum of 1-inch void between sleeve and building element.
 - c) Install type of fire-stopping material recommended by manufacturer.
 - 2. Install escutcheons, floor plates, or ceiling plates where exposed piping 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 sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations at computer rooms, electrical panel rooms, telecommunication rooms, and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.10 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements or Division 01 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed fire-stopping for compliance with specifications and submitted schedule.

3.11 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of fire-stopping materials.

3.12 PROTECTION OF FINISHED WORK

- A. Division 01 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

3.13 HANGER AND ROD SCHEDULE NOTES:

- 1. Where unusual concentrated loads of valves and fittings occur, closer spacing shall be required. Submit specific cases for review and comment.
- 2. Where piping changes direction, supports shall be placed in each direction adjacent to joints and no more than 12-inches from the joint.
- 3. Piping larger than 16-inches shall be supported according to the details on the drawings.

END OF SECTION 211104

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SECTION 212313 – WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.

1.2 SUMMARY

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 21 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 21 specifications contain statements more definitive or more restrictive.
- C. Section includes wet-pipe sprinkler system, system design, installation, and certification.
- D. Related Sections:
 - 1. Section 210503 - Electrical Work for Fire Protection Systems: Execution requirements for electric connections to equipment specified by this section.

1.3 REFERENCES

- A. Refer to Section 210501 for complete listing of references.

1.4 SYSTEM DESCRIPTION

- A. System to provide coverage for the areas as noted within the Contract documents.
- B. Provide hydraulically designed system to NFPA 13 Light Hazard, occupancy requirements unless otherwise noted on the drawings.
- C. Provide hydraulically designed system to NFPA 13 Ordinary Hazard, Group 1 occupancy requirements unless otherwise noted on the drawings.
- D. The Contractor shall obtain flow test data for the design of the hydraulic calculations. Design shall be based on flow test data and submitted to the Professional with the hydraulic calculations.
- E. Interface system with the building fire and smoke alarm system.
- F. Provide fire department connections as indicated on Drawings.

1.5 SUBMITTALS

- A. All submittals shall be reviewed and accepted by the Owner's Insurance Carrier and local Authority Having Jurisdiction prior to submittal to the Professional.
- B. Section 210502 - Fire Protection Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.

- C. Shop Drawings: Indicate layout of finished ceiling areas indicating sprinkler locations coordinated with ceiling installation. Indicate detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
- D. Product Data: Submit data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- E. Design Data: Submit design calculations; signed and sealed by a Professional Engineer.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- C. Operation and Maintenance Data: Submit components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 13, State, Federal, local code and the Authority Having Jurisdiction.
- B. Maintain one (1) copy of each document on site.

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 three years documented experience.
- C. Design system under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of North Carolina.

1.9 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Store products in shipping containers until installation.
- C. Furnish piping with temporary inlet and outlet caps until installation.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

1.12 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish extra sprinklers under provisions of NFPA 13.
- C. Furnish suitable wrenches for each sprinkler type.
- D. Furnish metal sprinkler head storage cabinet(s) in location designated by the Owner.

PART 2 PRODUCTS

2.1 LISTING / APPROVAL

- A. All sprinkler system materials and components must be UL Listed and FM Approved and used in strict conformance to the conditions of their Listing or Approval.
- B. All sprinklers shall be quick response type.
 - 1. Heads serving generator rooms and fuel storage rooms shall have a minimum 11.2 k-factor.
- C. Extended coverage heads shall not be permitted.
- D. Recessed pendant sprinkler head escutcheons shall be listed.
- E. Freezers with wet systems shall have dry pendant heads. The drops shall extend at least 12-inches above the freezer and be provided with insulating wrap to prevent sweating.
- F. Suspended Ceiling: Semi-recessed, pendant type with matching push-on escutcheon trim, chrome finish with glass bulb type or fusible link. Temperature rating of sprinkler head shall be suitable for specific area hazard.
- G. Exposed Areas: Standard upright type, brass finish with glass bulb type or fusible link. Temperature rating of sprinkler head shall be suitable for specific area hazard.
- H. Sidewall: Semi-recessed, quick response, chrome plated brass finished with glass bulb type or fusible link with matching push-on escutcheon trim. Temperature rating of sprinkler head shall be suitable for specific area hazard.

2.2 SPRINKLERS

- A. Manufacturers:
 - 1. Viking Corp.
 - 2. AFAC Inc.
 - 3. Central Sprinkler Corp.
 - 4. Firematic Sprinkler Devices, Inc.
 - 5. Globe Fire Sprinkler Corporation.
 - 6. Grinnell Fire Protection.
 - 7. Reliable Automatic Sprinkler Co., Inc.

8. Star Sprinkler Inc.
9. Venus Fire Protection, Ltd.
10. Victaulic Co. of America.

B. Suspended Ceiling Type:

1. Type: Recessed, Semi-recessed and Concealed pendant type with matching push on escutcheon plate.
2. Finish: Coordinate sprinkler and escutcheon finish and color with the Project Architect.
3. Fusible Link: Fusible solder link type or Glass bulb type; temperature rated for specific area hazard.

C. Exposed Area Type:

1. Type: Standard upright type with guard where required.
2. Finish: Brass.
3. Fusible Link: Fusible-solder link type or Glass bulb type; temperature rated for specific area hazard.

D. Side wall Type:

1. Type: Standard horizontal side wall type with matching push on escutcheon plate.
2. Finish: Coordinate sprinkler and escutcheon finish and color with the Project Architect.
3. Fusible Link: Fusible-solder link type or Glass bulb type; temperature rated for specific area hazard.

2.3 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: UL 193, 175-psig working pressure, designed for horizontal or vertical installation, with cast-iron flanged inlet and outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, precision retarding chamber, and fill line attachment with strainer.
- B. Water Motor Alarm: UL 753, mechanical operation type, 10-inch diameter, cast-aluminum alarm gong, with red enamel factory finish. Include Pelton-wheel-type operator with nylon shaft bearings, and shaft length and sleeve to suit wall thickness and construction; $\frac{3}{4}$ inch inlet with strainer and 1-inch drain.
- C. Water Flow Switch: UL 346, electrical-supervision type, vane-type water-flow detector, rated to 250 psig, and designed for horizontal or vertical installation. Include two (2) SPDT (single-pole, double-throw) circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere, 125 volts AC. (7A, 125 VAC) and 0.25 ampere, 24 volts DC (0.25 A, 24 VDC); complete with factory-set, field-adjustable retard element to prevent false signals and tamper-proof cover that sends a signal when cover is removed.
- D. Fire Department Connections: UL 405, cast-brass body; NH-standard thread inlets according to NFPA 1963 and matching local fire department threads.

1. Type: Exposed mounted wall type with chrome plated finish.
2. Threaded NPS outlet.
3. Inlets: Lugged swivel connections; drop-clappers for each hose connection with fire department thread size. Lugged and threaded dust-caps with gaskets and chain of matching material and finish.
4. Drain: 3/4-inch automatic drip, outside.
5. Label: Round wall escutcheon plate with marking "AUTO SPKR./STANDPIPE" Matching material and finish.

2.4 PRESSURE GAGES

- A. Pressure Gages: UL 393, 3½- to 4½-inches diameter dial with dial range of 0 - 250 psig.

2.5 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: In accordance with Division 26 and Section 210503.
- B. Controls: Supervisory switches, Flow Switches, Pressure Switches,

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 13.
- B. Install approved reduced pressure principle back-flow preventer assembly at sprinkler system water source connection.
- C. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent Siamese connectors to allow full swing of fire department wrench handle.
- D. Locate outside alarm-gong on building wall as indicated on Drawings.
- E. Place pipe runs to minimize obstruction to other work.
- F. All piping in finished areas shall be run concealed. The Contractor shall furr in piping or provide soffit as required and in accordance with the Professional's instructions. All piping shall be installed as required to suit space available in building structure, above suspended ceilings, and other locations found necessary for installation. Install piping as high as possible.
- G. The Contractor shall not install any piping that will interfere with any lights, openings, doors, windows, ductwork, equipment, and existing or special conditions. Headroom in front of openings, doors, or windows shall not be less than the top of the opening. Provide all piping offsets necessary to avoid interferences with other work. Piping offsets shall include all devices and assemblies necessary to accommodate the change in direction of the piping.
- H. All piping shall run straight with no more couplings and joints than necessary and shall be carefully installed to provide for proper alignment and slope.
- I. All piping shall be installed with not less than 2-inches between piping and all other work or piping.

- J. Reduction in sizes of pipes shall be made with reducing fittings. Bushings will not be permitted.
- K. Piping shall be properly arranged and graded to low points where the entire system can be emptied through a drain.
- L. Drain valves shall be provided to drain all sections of the piping system.
- M. Automatic sprinklers in the finished ceilings shall be located in accordance with the criteria defined in NFPA 13. These head locations shall be reviewed and approved by the Project Architect before the contractor begins his hydraulic calculations.
- N. Install guards on sprinklers where required by NFPA 13.
- O. Hydrostatically test entire system.
- P. Require test be witnessed by Fire Marshal, State Construction Office Representatives, Owner, and Architect/Engineer.

3.2 ELECTRICAL SUPERVISION

- A. Electrical supervision shall be provided for all sprinkler control valves, including the outside Post Indicator Valve or Wall-type Indicator Valve, EXCEPT that normally closed valves to test headers, hose connections on the roof, etc., shall only be provided with locks.

3.3 INSTALLATION, TEST, AND CERTIFICATION

- A. All sprinkler valves and controls shall be located for safe and convenient access during emergencies and testing. Control valves shall not be located above ceilings. Inspector's Test Connections should be operable from floor level.
- B. Identify each valve and control with a prominent engraved phenolic or stamped metal placard. Any such devices which are behind access doors or panels must also have an appropriate placard on the means of access.
- C. Provide an auxiliary drain for each location where the piping pitch prevents complete drainage through the main drain valve. If the capacity of the trapped section exceeds five (5) gallons, a valve must be provided, and the outlet piped to a drain or convenient location acceptable to the Authority Having Jurisdiction.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Verify signal devices are installed and connected to fire alarm system.
- B. Each retard shall be tested and adjusted for a 20 to 40 second delay.
- C. Electrical supervision shall be provided for all sprinkler control valves, including the outside Post Indicator Valve or Wall-type Indicator Valve, EXCEPT that normally closed valves to test headers, hose connections on the roof, etc., shall only be provided with locks. All sprinkler, flow and tamper switches shall be furnished and installed by this contractor and wired by Division 26.

3.5 CONTRACTOR'S INSPECTION OF SYSTEM

- A. The Contractor shall thoroughly inspect the completed system to assure compliance with this document, project plans and specs, and all applicable Codes and Standards. This must include an

operational test of each water flow alarm switch and all system supervisory devices (valve tamper, hi-low air pressure, fire pump status, etc., where provided). This testing shall be performed in coordination with the fire alarm system contractor.

- B. At the final inspection, the fire sprinkler contractor should have for review and closeout documentation all pertinent NFPA paperwork properly filled out on NFPA forms as applicable (NFPA 13, 14, 20, 24). The shop drawing approval letter from this office should be available. A set of as-built fire sprinkler shop drawings and hydraulic calculations shall be placed in a white PVC tube marked "Fire Sprinkler Shop Drawings" and securely fixed in the fire sprinkler riser room.

3.6 CONTRACTOR'S MATERIAL AND TEST CERTIFICATES

- A. Prior to requesting the Professional to set up the final inspection, complete and submit copies of the MATERIAL AND TEST CERTIFICATES to the following:
 - 1. Professional
 - 2. Owner
 - 3. Local AHJ.

3.7 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Flush entire piping system of foreign matter.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 - Execution and Closeout Requirements: Protecting installed construction.
- B. Apply masking tape or paper cover to protect concealed sprinklers, cover plates, and sprinkler escutcheons not receiving field paint finish. Remove after painting.
- C. Replace inadvertently painted sprinklers with new.

END OF SECTION 212313

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DIVISION 22 - PLUMBING SPECIFICATIONS
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SECTION 220100 – PLUMBING GENERAL

PART 1 GENERAL

1.1 STIPULATIONS

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 1 Specification Section apply to all work in this section.
- B. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 22 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 22 specifications contain statements more definitive or more restrictive.
- C. Nothing herein contained shall be so construed to relieve the Contractor from doing his work according to the true intent and meaning of these drawings and specifications. He will be held to provide and install all materials and equipment and shall furnish all labor necessary for the complete, prompt and satisfactory execution of the work. He is also responsible for the proper coordination of his work with all other trades.
- D. The Contractor shall bear all expenses incidental to the satisfactory completion of the work contained in these specifications and drawings.

1.2 SCOPE

- A. Work consists of furnishing all labor, material, equipment and services necessary and reasonably incidental to the proper completion and proper operation of the plumbing systems. The work shall consist of but shall not necessarily be limited to the following:
 - 1. Domestic water system including extension of piping and connections to all equipment, fixtures, water heaters, and accessories. The Domestic water system shall be extended from a point 5 (five) feet beyond the exterior face of the building.
 - 2. Sanitary drain, waste and vent system including connection to all equipment, fixtures, and accessories. The sanitary system shall be extended to a point 5 (five) feet beyond the exterior face of the building. Final installation at the point of connection shall be made.
 - 3. Plumbing Piping as specified in Section 220503.
 - 4. Plumbing Specialties as specified in Section 220508.
 - 5. Plumbing Fixtures as specified in Section 224000.

1.3 DEFINITIONS

- A. Words and phrases used throughout the contract documents shall be interpreted as indicated below:
1. Contractor - The person or organization awarded the contract for construction services. In the case of a construction project administered as a multiple-prime contract, the term shall be further defined as the Contractor holding a prime contract for plumbing construction work. The term "Plumbing Contractor" is used interchangeably with the term Contractor.
 2. Provide - To furnish and install materials, equipment or systems.
 3. Submittals - Submittals shall include manufacturers' catalog data, shop drawings, calculations, certificates of compliance, testing reports, samples, and operation and maintenance manuals.
 4. Professional - The Engineer of record.
 5. Work By Others - Work provided by a person or organization other than the Contractor.

1.4 CODES, REFERENCES AND STANDARDS

- A. The Contractor shall comply with all laws, ordinances, and regulations of all authorities having jurisdiction, including those of all applicable city, county, state, federal and public utility entities. The Contractor shall obtain all licenses, permits, etc. and shall pay all associated connection fees, tapping fees, inspection fees, etc. This cost shall be included in the contract price.
- B. The publications listed below form a part of this specification. All publications shall be the latest edition as adopted by the authority having jurisdiction. The minimum standard of work under this contract shall be in accordance with the following model building codes:
1. North Carolina State Building Code:
 - a. Building, 2018 edition
 - b. Plumbing, 2018 edition
 - c. Mechanical, 2018 edition
 - d. National Electric Code, 2018 edition
 - e. Fire Prevention, 2018 edition
 - f. Fuel Gas, 2018 edition
- C. The publications are referred to in the text by basic designation only.
1. American Iron and Steel Institute (AISI)
1140 Connecticut Avenue
Washington, DC 20036
 - a. Stainless Steel Tubing AISI 316L

2. American Water Works Association (AWWA)
6666 West Quincy Avenue
Denver, Colorado 80235
 - a. Cement Mortar Lining for Ductile-Iron Pipe ANSI A21.4 AWWA C104
 - b. Rubber Gasket Joints for Ductile-Iron Pipe ANSI A21.11 AWWA C111
 - c. Ductile-Iron Pipe ANSI A21.51 AWWA C151

3. American National Standards Institute (ANSI)
11 W. 42nd St.
New York, New York 1003
 - a. Cement Mortar Lining for Ductile-Iron Pipe ANSI A21.4 AWWA C104
 - b. Rubber Gasket Joints for Ductile-Iron Pipe ANSI A21.11 AWWA C111
 - c. Ductile-Iron Pipe ANSI A21.51 AWWA C151
 - d. Cast Iron Screwed Fittings ANSI B16.4
 - e. Cast Iron Drainage Fittings, Threaded ANSI B16.12
 - f. Pipe Fittings, Bronze, and 250 lb. Cast ANSI B16.15
 - g. Cast Copper Alloy Solder-Joint Pressure Fittings ANSI B16.18
 - h. Solder-Joint Fittings, Pressure Wrought Copper
 - i. and Copper Alloy ANSI B16.22
 - j. Cast Copper Alloy Solder-Joint Drainage Fittings ANSI B16.23
 - k. Bronze Pipe Flanges and Flanged Fittings ANSI B16.24
 - l. Solder-joint fittings, Drainage, DWV Wrought ANSI B16.29
 - m. Copper and Copper Alloy
 - n. Gas Water Heaters ANSI Z-21-10.3

4. American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE)
1791 Tullie Circle NE
Atlanta, GA 30329
ASHRAE 90A

5. American Society of Mechanical Engineers (ASME)
345 East 47th Street
New York, New York 10017
 - a. Cast Copper Alloy Fittings for Flared Copper Tubes ASME B16.26
 - b. ASME Boiler and Pressure Vessel Code.
 - (1) Section IV Low Pressure Heating Boilers.
 - (2) Section VIII, Unfired Pressure Vessels.

6. American Society of Testing and Materials (ASTM)
1916 Race Street
Philadelphia, PA 19103
 - a. Cast Iron Soil Pipe and Fittings Hub and Spigot ASTM A74
 - b. Seamless Copper Water Tube ASTM B88
 - c. Copper Tube, Drainage DWV ASTM B306
 - d. Recommended Practices for Laying Sewer Pipe ASTM C-12
 - e. PVC Pipe - Schedule 40 ASTM D1785
 - f. Pipe Fittings, PVC, Schedule 40 ASTM D2466
 - g. Sand Cone Method ASTM D1557

- h. Method D and ASTM D1556
 - i. Billet-Steel Bars for Concrete Reinforcement ASTM A615
- 7. Cast Iron Soil Pipe Institute (CISPI)
1400 Chain Bridge Road
McLean, VA 22101
 - a. Cast Iron Soil Pipe and Fittings for Hubless CISPI301
Cast Iron Sanitary Systems
- 8. Compressed Gas Association, Inc. (CGA)
4221 Walney Road, Fifth Floor
Chantilly, VA 20151-2923
 - a. Pamphlet P-2.1
 - b. Pamphlet P-2.7
 - c. Pamphlet V-5
- 9. Manufacturer's Standardization Society (MSS)
5203 Leesburg Pike, Suite 502
Falls Church, VA 22041
 - a. Unions, Brass or Bronze, 250 pounds MSS-SP-72
 - b. Pipe Hangers and Supports – Materials, Design MSS-SP58-88
and Manufacturer.
 - c. Pipe Hangers and Supports – Selection MSS-SP69-91
and Application
- 10. North Carolina Department of Labor
Boiler and Pressure Vessel Division
4 West Edenton Street
Raleigh, North Carolina 27601-1092
 - a. The Uniform Boiler and Pressure Vessel Act of North Carolina and Administrative
Rules - January 1998
- 11. Plumbing and Drainage Institute (PDI)
45 Bristol Drive, Suite 101
South Easton, MA 02375
 - a. Shock Absorbers PDI WH 201

1.5 QUALITY ASSURANCE AND COORDINATION

- A. The Contractor shall coordinate his work with that of the other trades. Where interference with other trades occurs, the Contractor shall present his solution to the Professional. The Professional shall make the final decision regarding changes to be made in the work.
- B. The Contractor shall thoroughly familiarize himself with all specifications and drawings for the project so that he clearly understands his responsibility in relationship to the work to be

performed. The Contractor shall plan and perform his work so as to permit the use of the building at the earliest possible date.

- C. The Contractor shall guarantee all work, materials and equipment furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of the Owner's final acceptance, or as indicated in the General Conditions. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.
- D. The Contractor shall expressly and completely follow all manufacturers' instructions required for validation of the manufacturer's warranty agreement including but not limited to service, maintenance and adjustments of the equipment.
- E. The Contractor is responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the contract documents.

1.6 PROJECT RECORD DRAWINGS

- A. Changes from the contract drawings necessary to coordinate the work with other trades, to conform to the building conditions or to conform to the rules and regulations of authorities having jurisdiction shall be made only after obtaining written permission from the Professional.
- B. The Contractor shall keep a record of construction changes and deviations from the original contract drawings. All changes shall be recorded on a separate set of prints, which shall be kept at the job site specifically for that purpose. The record shall be made immediately after the work is completed. Documentation shall include:
 - 1. Location and elevation of new and existing utility lines.
 - 2. Points of connection to existing utility pipelines.
 - 3. Changes in pipe routing location.
 - 4. Valve locations.
 - 5. Equipment locations, etc.
 - 6. Actual capacities and values of equipment provided as indicated in equipment schedules
- C. The marked-up record set of drawings shall be delivered to the Professional before final acceptance of the Plumbing Contract work.

1.7 FIELD MEASUREMENTS

- A. The Contractor is responsible to verify the location of any and all existing underground utilities in the vicinity of his work. When it has been indicated that these utilities are to remain in place,

the Contractor shall provide adequate means of support and protection during excavation operations.

- B. Before ordering any equipment and material, or performing any work, the Contractor shall verify all measurements and dimensions at the job site. The Contractor is responsible for the correctness of this information.
- C. No extra compensation will be considered based on differences between actual dimensions and measurements and those indicated on the drawings.
- D. Any difference identified by the Contractor shall be submitted to the Professional for consideration before proceeding with the work.

1.8 PROTECTION OF SERVICES AND EQUIPMENT

- A. All existing service utilities shall remain active during construction. Any service underground, aboveground, interior or exterior damaged, broken or otherwise rendered inoperative during the course of construction due to activities on the part of the Contractor shall be properly repaired by the Contractor, at his own expense. The method used in repairing, replacing or maintaining the services shall be submitted to the Professional for review and approval.
- B. At his own expense, the Contractor shall protect his work, materials or equipment that is subject to damage during the project duration. All openings into any piping, ducts or equipment shall be securely covered, or otherwise protected, to prevent injury due to carelessly or maliciously dropped tools or materials, grit, dirt, or any foreign material. The Contractor is responsible for all damage until his work is fully and finally accepted.
- C. The Contractor is responsible to provide protection for motors, pumps, electrical equipment, and all similar items of equipment from dirt, grime, plaster, water, etc. during all phases of construction. This protection shall be provided by covering equipment with transparent plastic sheeting and/or locating the materials and equipment in an area free from the elements.

1.9 INTERRUPTION OF SERVICES

- A. The Contractor shall schedule his work to avoid any major interruption of any utility services.
- B. Existing utilities serving occupied facilities shall not be interrupted except when such interruptions have been authorized in writing by the Owner or the Professional. Interruptions may occur only after acceptable temporary utility services have been provided. The Contractor shall provide a minimum of ten-(10) working days' notice to the Professional and Owner, and receive written notice to proceed before interrupting any utility.

1.10 CLEANUP

- A. The Contractor shall maintain buildings, grounds, and public properties free from accumulations of waste materials, debris and rubbish. At reasonable intervals during the progress of work, and when directed by the Owner's authorized representative, the site and public properties shall be cleaned and waste materials, debris and rubbish disposed of in an

appropriate manner. The Contractor shall provide containers for collection of waste materials, debris, and rubbish. Waste materials, debris and rubbish shall be removed from the job site and legally disposed of at a landfill area in accordance with all applicable regulations. Burning or burying waste materials, debris or rubbish on project site is not permitted.

- B. At the completion of the Project, remove waste materials, rubbish, tools, equipment, machinery, surplus materials, etc., and clean all sight-exposed plumbing fixtures and equipment. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed plumbing fixtures and equipment. Broom clean paved and concrete surfaces. Rake clean other ground surfaces. Repair, patch and touch up marred surfaces to specified finish or to match adjacent surfaces.

1.11 SUBMITTALS

- A. General

- 1. Refer to Section 220100 of this manual for the requirements relating to shop drawings and submittals.

1.12 EXCAVATION, BACKFILLING AND COMPACTION

- A. Excavation, Backfilling and Compaction shall comply with Division 2 of the Project Manual.

- B. General

- 1. The Contractor shall notify "ONE CALL" prior to any work.
 - 2. The Contractor shall perform all excavation, backfilling, compaction and necessary finishing for all piping, equipment, and accessories. Piping installation shall be in accordance with local water, sewer and gas utility regulations and applicable state and local codes.
 - 3. The Contractor shall do all bracing, sheathing, and shoring necessary to perform and protect his excavations. The Contractor shall provide safety rails, lights, signs, etc. as necessary or required for safety, or as required to conform to governing codes and laws.
 - 4. The Contractor shall provide, maintain, and operate pumping equipment of sufficient capacity to ensure that all his excavations and trenches are kept free of water at all times.
 - 5. All surfaces of streets, walkways, seeded areas, or finished grade areas disturbed by the excavation shall be restored to their original condition and/or as indicated on the contract documents.
 - 6. Protect existing structures, utilities, sidewalks, pavements and other facilities not indicated for removal, from damage caused by settlement, lateral movement, undermining, washout and other hazards resulting from excavation operations.
 - 7. Existing utility lines shown on the contract documents do not indicate the exact in-place location of the lines. They do not show every pipe, fitting or appurtenance that may exist

at the project site. The location and depth of all utilities shall be marked and recorded prior to any excavation. Should uncharted or incorrectly charted piping or other utilities be uncovered during excavation, contact the Professional immediately for directions before proceeding further with work in this area. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner.

8. If it becomes necessary to install any lines or equipment in locations other than those shown, the Professional's acceptance shall be obtained before starting the excavation.
9. The presence of explosives on the project site or the use of explosives in the execution of the work under this contract is prohibited.

C. Excavation

1. All plumbing excavation is unclassified.
2. Trenches shall be dug to uniform width not less than 12-inches, nor more than 16-inches wider than the bell diameter of the piping. Trench sides shall be vertical. Excavate trenches to depth indicated or required. Carry depth of trenches for piping as required to establish required slopes and invert elevations. Beyond building perimeter, keep bottom of trenches sufficiently below finished grade to protect against frost. The bottom of trenches shall be accurately graded to provide uniform and smooth flow throughout. Any over-excavation shall be backfilled with modified aggregate and thoroughly tamped.
3. If trench excavation operations are performed when the atmospheric temperature is less than thirty-five (35) degrees Fahrenheit, the Contractor shall provide at his own expense cold weather protection as required to protect excavated trench bottoms from freezing. Piping shall not be placed in a trench containing water, or on a sub-grade containing frost.
4. Take up and re-lay pipe that is not laid true to required alignment or grade. Pipe that has had its joints disturbed after installation shall be taken up and relayed. Deviation from the required lines and grades will not be permitted unless approved by the Professional.
5. Excavation for the various catch basins, pits, manholes, tanks, etc., shall follow the general procedures as outlined above. The excavation shall extend as required for proper installation or construction. Backfill shall be carefully placed in layers and tamped.
 - a. The base for all tanks, pits, manholes, etc., shall be a minimum of 12-inches compacted fill in 4-inch layers to ninety-five (95%) percent compaction or as detailed and noted on the contract documents.
6. All underground piping shall be laid on first class granular bedding. The bedding shall be a minimum depth of six (6) inches or 1/4 (one-fourth) the pipe diameter, whichever is greater. The bedding shall provide uniform longitudinal support to the pipe and shall be laid to provide the grade and line as shown on the drawings or as directed by the Professional. Hand tamp the embedment materials under the haunches and around the pipe to the spring-line of the pipe to a compaction density of ninety-five (95) percent. Final embedment for ferrous pipe materials shall extend from the spring-line of the pipe to a depth of 6 inches (minimum) above the top of the pipe. Final embedment for PVC

pipe shall extend from the spring-line of the pipe to a depth of 18 inches (minimum) above the top of the pipe.

D. Backfilling

1. Backfilling shall not be undertaken until all tests and inspections have been made. Use care to avoid damaging or displacing piping systems. All backfill material shall be free from cinders, ashes, refuse, organic material, boulders, rocks or stones, frozen soil, or other material that is unsuitable. When the type of backfill material is not indicated on the plans or is not specified, the excavated material may be used, provided that such material consists of loam, clay, sand, gravel, or other material that is suitable for backfilling. From 1-foot above the top of the pipe to the sub-grade of the pavement, material containing stones greater than 6-inches in their greatest dimension may not be used.
2. Backfill shall be carefully performed and the original surface restored.
3. All trench backfill shall be brought to sub-grade ready for base material or topsoil. After the initial aggregate backfill layer has been placed, refill remainder of the trench using backfill materials as follows:
 - a. Lawns - Successive 6-inch layers of clean earth backfill material shall be deposited after initial aggregate backfill. This backfill shall consist of excavated material free from large clods of earth and stone. If large stones (greater than 6-inches) are encountered, remove stones from site and haul in clean earth backfill. The entire trench shall be uniformly tamped after each successive layer is deposited. Replace topsoil to approximate depth of existing as final refill operation and crown to such height as required by the Professional. Maintain crowned surface to the satisfaction of the Professional.
 - b. Walks and Parking Areas - Clean earth backfill compacted in 6-inch layers to a point 8-inches below the adjacent existing surfaces. Refill the remaining 8-inches with compacted stone and replace walk or paving as required.
 - c. Paved Areas - When working within the right-of-way limits of all North Carolina State highways, backfilling must be in conformance with the requirements of the North Carolina Department of Transportation, which is made a part of these specifications by this reference thereto. Trenches located within the areas described above shall be backfilled with aggregate material from the top of the "pipe bedding" to the bottom elevation of the pavement structure and must be spread and compacted in layers not to exceed 4 inches when using a mechanical damper. The Contractor is to understand that payment for special backfilling material shall not be made unless specifically provided in the form of Proposal.

E. Compaction

1. Backfill trenches to point twelve (12) inches above the top of the outside barrel of the pipe. Continue thereafter with the backfill in twelve (12) inch lifts.
2. All backfill shall be compacted to ninety-five (95) percent. Each lift shall be compacted to the specified percent of maximum density obtained at optimum moisture content, in accordance with ASTM D1557, method D and ASTM D1556 sand cone method.

3. Compaction shall be accomplished by approved equipment suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
4. Thoroughly compact successive layers of backfill material with a vibrating compactor of a type and size satisfactory to the Professional. Compacting of this backfill by puddling or jetting will not be permitted. Use mechanical tampers to compact backfill materials in trench refill operations to produce a density of backfill at the bottom of each layer of not less than 95-percent of the maximum density obtained at optimum moisture content.
5. The use of special equipment such as the "HYDRA-HAMMER" for compaction of backfill is prohibited.

1.13 CONCRETE

- A. Reinforcing shall conform to ASTM A-615, Grade 60. Concrete exposed to freezing and thawing, salts, sulfates and corrosion shall comply with North Carolina State Building Code.
- B. All concrete shall be of minimum 3000 pounds per square inch (psi) strength in 28 (twenty-eight) days. All concrete shall be mixed by machine. No wet or moistened mixture containing cement shall remain unplaced for a period exceeding 30 (thirty) minutes and shall not be used after its initial set. Re-tempering after initial set is prohibited. Exposed surfaces shall be protected from drying for at least 7 (seven) days. All forms shall be built true and rigid. Form removal shall not injure the concrete.
- C. All concrete is to be finished with a hard, smooth troweled finish and is to be faced smooth with rounded corners.

1.14 INSPECTION AND TESTING

- A. General
 1. New plumbing systems and parts of existing systems, which have been altered, extended or repaired, shall be tested to disclose leaks and defects.
 2. The Contractor shall notify the Professional a minimum of five (5) working days prior to testing to coordinate the testing and inspection procedures.
 3. If the Professional determines that the plumbing systems do not pass the prescribed tests, the Contractor shall be required to make the necessary repairs, at his own expense. The Contractor shall re-inspect and re-test the systems. Repairing, inspection and testing shall be continued until all systems pass as determined by the Professional.
 4. All new, altered, extended or replaced plumbing shall be left uncovered and unconcealed until it has been inspected, tested and accepted by the Professional. Where such work has been covered or concealed before it has been inspected, tested and accepted, it shall be uncovered by the Contractor, at his own expense as directed by the Professional.

5. The Contractor shall furnish all equipment, material, labor, etc. required for testing the plumbing systems.

B. Sanitary, Vent, and Storm Drain Systems

1. The systems shall be tested in accordance with the North Carolina State Building Code, Plumbing.
2. Rough Plumbing - Systems shall be tested upon completion of the rough piping installation and proved watertight. The water test shall be applied to the system either in its entirety or in sections after rough piping has been installed.
 - a. Where applied to the entire system, all openings in the piping shall be closed, except the highest opening, and the system filled with water to point of overflow.
 - b. Where the system is tested in sections, each opening shall be plugged, except the highest opening of the section under test, and each section shall be filled with water. A section shall not be tested with less than a 10-foot head of water.
 - c. All joints or pipes in the building, except the uppermost 10 feet of the system, shall be subjected to a test of less than a 10-foot head of water.
 - d. The water shall be kept in the system or in the portion under test for a minimum of 2 (two) hours before inspection starts. The system shall then be inspected to ensure that it is tight at all points.
3. Finished Plumbing - after the plumbing fixtures have been set and their traps filled with water, the plumbing fixture connections shall be tested and proved gas and watertight.
 - a. A smoke test shall be made by filling all traps with water and then introducing into the system smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a 1-inch water column shall be introduced and maintained for the period of the inspection.
 - b. Where the local Authority Having Jurisdiction finds that a smoke test need not be performed, a peppermint test shall be performed. Two (2) ounces of oil of peppermint shall be poured into the roof terminal of every line or stack to be tested. The oil of peppermint shall be followed at once by 10 quarts of hot (140-degrees Fahrenheit) water. All roof vent terminals shall then be sealed. The system shall then be inspected for the detection of odor of peppermint. If odor of peppermint is detected, repairs shall be made and the system shall be retested.

C. Building Sewer

1. The building sewer shall be tested by insertion of a test plug at the point of connection with the public sewer. The building sewer shall then be filled with water under a head of not less than 10-feet. The water level at the top of the test head of water shall not drop for at least 15 (fifteen) minutes.

D. Domestic Water Systems

1. The system shall be tested either in its entirety or in sections.
2. The system shall be tested and proved tight under a water pressure of 150 pounds per square inch for a period of 2 hours.
3. Potable water shall be used for testing.

E. Fuel Gas Systems

1. The systems shall be tested in accordance with NFPA 54.
2. All fuel gas piping shall be pneumatically tested for tightness prior to commencement of gas service. Air or nitrogen shall be used as the test medium. For low pressure systems the piping system shall be pressurized to a minimum of 10 psig for a period of not less than 10 minutes without showing any drop in pressure. For high pressure systems, 5 PSI and greater, the piping system shall be pressurized to at least 50 psig for not less than 10 minutes without showing any loss of pressure. All joints shall be leak tested with detection solution while the system is pressurized. The Contractor shall provide a valved 1/4 inch FPT connection in the system to which shall be attached a 24 hour pressure recording gauge. The Contractor shall arrange for a gas company representative to witness the test. Leaks shall be repaired by tightening or replacing joints. Caulking of joints is not permitted.

1.15 STERILIZATION OF THE DOMESTIC WATER SYSTEM

- A. After the system has been tested and approved, the entire new system, including valves and accessories, shall be chlorinated. Disinfecting shall be in accordance with AWWA C651.
- B. Chlorine may be applied in any of the following forms:
 1. Liquid chlorine gas-water mixture
 - a. Chlorine gas-water mixture shall be applied by a solution feed chlorinating device.
 2. Calcium hypochlorite and water mixture.
 - a. Calcium hypochlorite shall be HTH, Perchlone and Maxochlor, or accepted substitute. A solution consisting of five (5%) percent powder to ninety-five (95%) percent water by weight shall be prepared. The calcium hypochlorite and water mixture, first made into a paste and then thinned to a slurry, shall be injected or pumped into the system.
- C. The system or any part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million of chlorine. The system or part thereof shall be valved off and allowed to stand for 24 hours. Or the system or any part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million of chlorine and allowed to stand for 3 hours. During the chlorination process all valves and accessories shall be operated.
- D. After the chlorination process, the chlorine shall be flushed from the system until the system water is equal in chemical and bacteriological composition to those of the permanent source of

water supply. Spent chlorinated water shall be disposed of with in an environmentally responsible procedure.

- E. The Contractor shall submit samples of the system water to a competent laboratory for analysis. Laboratory tests of the water shall be paid for by the Contractor. The “Water Test Report for Use” shall be submitted to the Engineer of Record for review and approval.
- F. Water supply shall not be placed into service until bacteriological test results are found to be satisfactory and the water meets EPA quality standards for drinking water. After acceptance by the Engineer of Record, the “Water Test Report for Use” shall be submitted to the State Construction Office prior to sending a request for Final Acceptance and Occupancy Permit.

1.16 INSTRUCTION OF THE OWNER

- A. After acceptance of the Project, the Contractor shall furnish the services of personnel thoroughly familiar with the completed installation to instruct the Owner in the proper operation and maintenance of all equipment and appurtenances provided.
- B. The Contractor shall provide the Owner with two (2) weeks advance notice before the instruction session.

1.17 CHASES AND OPENINGS

- A. All openings required for the installation of the work shall be coordinated with the other trades. The Contractor shall provide the other trades with sufficient time (one (1) week minimum) for coordination of all openings. The Contractor shall be responsible for cutting and patching all openings necessary for his work. The work shall be performed to the satisfaction of the Professional.
- B. Penetrations made in fire rated partitions, floors, etc. shall be sealed with an approved material and method as required to maintain the integrity of the fire separation.
- C. The Contractor shall provide all sleeves, hangers, and anchors required for installation of the work in chases and openings.

1.18 WATER SERVICE AND METERS

- A. The Contractor shall coordinate water meter requirements in accordance with the local water utility regulations, including required permits, meters, piping, valves, bypasses, supports and other accessories.

1.19 PAINTING

- A. Painting shall be in accordance with Division 9.

1.20 RELATED WORK

- A. All work related to providing complete plumbing systems and equipment shall be the responsibility of the Contractor. The following related work shall be provided as indicated in other specification divisions, unless noted otherwise, but shall remain the responsibility of the Contractor for workmanship and completeness:

1. General Contractor

- a. Installation of access panels.
- b. Leaders and gutters.
- c. New catch basins and foundation drains. Final connections shall be by the Contractor, as indicated on the drawings and as herein specified.
- d. Final painting of existing walls, floors and ceilings where the surfaces are being refinished and remodeled under the general contract. Refer to general construction drawings.
- e. Equipment and furnishings including shop equipment and laboratory equipment. The Contractor shall make all final connections to equipment and furnishings. The Contractor shall be responsible for coordination of plumbing services with the equipment and furnishings.

2. Mechanical Contractor

- a. Side wall ventilators and air conditioning equipment.

3. Electrical Contractor

- a. Verification of the proper rotation of three-phase equipment, and making modifications as required to correct improper rotation.
- b. Installation of all combination starters/disconnects and overload protectors.

1.21 MISCELLANEOUS STEEL AND ACCESSORIES

- A. The Contractor shall provide all necessary steel angles, channels, pipe, rods, nuts, bolts, etcetera, as shown on plans, as specified, or as may be required for complete and proper installation of plumbing fixtures, systems, and equipment. All material and workmanship shall be of the best quality and shall be installed in accordance with the best practices of the trade.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials used on plumbing systems shall comply with the following lead ban requirements:

1. Solders with lead content exceeding 0.2% (two-tenths of a percent) are prohibited. Brass and bronze materials containing 2.0% (two percent) or greater lead are prohibited.

PART 3 EXECUTION

3.1 GENERAL

- A. The contract drawings are diagrammatic and are indicative of the work to be performed. It is not intended that they show every pipe, fitting or apparatus required for a complete installation.
- B. The contract documents are not intended to indicate every bend, offset, change in direction and appurtenance required to provide a complete and workable system.
- C. All materials and equipment used shall be installed in strict accordance with the standards under which the materials are accepted and approved, and in strict accordance with the manufacturer's instructions.
- D. Except where otherwise indicated, minimum cover on site shall not be less than the following:
 1. Sanitary sewer piping: 3'-0"
 2. Storm drain piping: 2'-0"
 3. Domestic water piping: 3'-0"
 4. Natural gas piping: 2'-0"

END OF SECTION 220100

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SECTION 220501 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 22 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 22 specifications contain statements more definitive or more restrictive.
- C. Nothing herein contained shall be so construed to relieve the Contractor from doing his work according to the true intent and meaning of these drawings and specifications. He will be held to provide and install all materials and equipment and shall furnish all labor necessary for the complete, prompt and satisfactory execution of the work. He is also responsible for the proper coordination of his work with all other trades.
- D. The Contractor shall bear all expenses incidental to the satisfactory completion of the work contained in these specifications and drawings.

1.2 SCOPE

- A. Perform work and provide material and equipment as shown on Drawings and/or as specified and/or indicated in this Section of the Specifications. Completely coordinate work of Divisions 22 with work of other trades and provide a complete and fully functional installation.
- B. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.
- C. It is the intent that these Specifications and Drawings are to establish minimum requirements for methods, products and equipment and to provide electrical service, distribution and systems finished, tested and ready for operation. Incidental detail not usually shown or specified, but necessary for proper installation and operation shall be included in the work and this Contractor's estimate, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each raceway and piece of equipment to minimize conflicts with other trades.
- D. Give notices, file plans, obtain permits and licenses, pay fees and back-charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

- E. Division 22 Contractor shall furnish all motor starters and disconnect switches as required by NEC for equipment motors, unless specifically noted otherwise in the specifications or on the drawings. Motor starters and disconnect switches shall be in accordance with Division 26 Specifications.
- F. If a Guaranteed Maximum Price (GMP) has been prepared using documents prior to the issuance of the 100% Bid Documents, the Contractor shall identify any and all changes to the documents (both drawings and specifications) that are affecting the GMP, either increasing or decreasing the GMP amount. All changes shall be numbered and circled, in both drawings and specifications. The Contractor shall also provide detailed cost back-up for all items noted above.
- G. Work consists of furnishing all labor, material, equipment and services necessary and reasonably incidental to the proper completion and proper operation of the plumbing systems. The work shall consist of but shall not necessarily be limited to the following:
1. Domestic water system including extension of piping and connections to all equipment, fixtures, booster pumps, water heaters, and accessories. The Domestic water system shall be extended from a point five (5)-feet beyond the exterior face of the building.
 2. Sanitary drain, waste and vent system including connection to all equipment, fixtures, and accessories. The sanitary system shall be extended to a point five (5)-feet beyond the exterior face of the building. Final installation at the point of connection shall be made.
 3. Rainwater collection system including extension of piping to roof drains. The rainwater collection system shall be extended to a point five (5)-feet beyond the exterior face of the building.
 4. Domestic Water Systems as defined in the Contract Documents.
 5. Natural Gas Distribution Systems as defined in the Contract Documents.
 6. Sanitary drainage systems as defined in the Contract Documents.
 7. Storm Water Collection Systems as defined in the Contract Documents.
 8. Sump Pumps as defined in the Contract Documents.
 9. Plumbing Pumps as defined in the Contract Documents.
 10. Sanitary Waste Interceptors as defined in the Contract Documents.
 11. Domestic Water Heaters as defined in the Contract Documents.
 12. Plumbing Fixtures as defined in the Contract Documents.
- H. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 22 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 22 specifications contain statements more definitive or more restrictive.

- I. Nothing herein shall be so construed to relieve the Contractor from doing his work according to the true intent and meaning of the drawings and specifications. He will be held to provide and install all materials and equipment, and shall furnish all labor necessary for the complete, prompt and satisfactory execution of the work. Also he is responsible for properly coordinating his work with all other trades.
- J. The contractor shall bear all expenses incidental to the satisfactory completion of the work contained in these specifications and drawings.
- K. Related Sections:
 - 1. Division 03 - Concrete Forming and Accessories: Execution requirements for inserts and sleeves specified by this section.
 - 2. Division 07 - Firestopping: Execution and material requirements for fire proofing of penetrations of rated construction.
 - 3. Division 09 - Painting and Coating: Execution requirements for piping painting specified by this section.

1.3 DEFINITIONS AS USED IN THESE SPECIFICATIONS

- A. "Provide," means "furnish and install."
- B. "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support."
- C. "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."
- D. "Architect" means the "Prime Design Consultant," and if United Engineering Group, Inc. is not the prime design consultant, the Architect may authorize United Engineering Group to act on the Architect's behalf in matters concerning the Division 22 series of specifications.
- E. "RFI" means Contractor's "Request for Information."
- F. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- G. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- H. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- I. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

- J. 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.
- K. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PP: Polypropylene plastic.
 - 5. PVC: Polyvinyl chloride plastic.
- L. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 CONTRACT DOCUMENTS

- A. Listing of Drawings does not limit responsibility of determining full extent of work required by these Contract Documents. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, Site Utility and all other Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of Division 22 must be coordinated.
- B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.
- D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.
- E. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.
- F. Data that may be furnished electronically by the Architect (on computer tape, diskette, or otherwise) is diagrammatic. Such electronically furnished information is subject to the same

limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not substitute for Architect's sealed or stamped construction documents.

1.5 DISCREPANCIES IN DOCUMENTS

- A. Where Drawings or Specifications conflict or are ambiguous, the contractor shall advise the Architect in writing before Award of Contract. Otherwise, Architect's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or ambiguities thus resolved.
- B. Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert Architect in writing before installation. Otherwise, make changes in installed work as Architect requires within Contract Price.
- C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specifications, this contractor shall provide that material, installation, or work which is of the higher, more stringent standard.
- D. The Contract Documents require the Contractor to provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the Contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.
- E. In cases covered by Paragraph (D) above, where the Contractor believes he needs engineering guidance, he shall submit a sketch identifying his proposed solution and the Architect shall review and advise the contractor of the disposition.

1.6 MODIFICATIONS IN LAYOUT

- A. Plumbing Drawings are diagrammatic. They indicate general arrangements of plumbing systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.
- B. In order to obtain the Architect's desired aesthetics in spaces used by building occupants, in all such spaces, prior to installation of visible material and equipment (including access panels) review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.
- C. Check Contract Documents, as well as Submittals and Shop Drawings of all subcontractors to verify and coordinate spaces in which work of Division 22 will be installed.
- D. Maintain maximum headroom at all locations. All piping, duct, conduit and associated components to be as tight to underside of structure as possible.

- E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C and D above. Systems shall be run in a rectilinear fashion.
- F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

1.7 REQUESTS FOR INFORMATION (RFI'S)

- A. If the RFI is a request to resolve a conflict or an ambiguity, or a request for additional detail, Contractor's RFI shall include a sketch or equivalent description of Contractor's proposed solution, in accordance with paragraphs 1.5 (E) and 1.6 (F) above.
- B. To expedite the flow of RFI's, for all RFI's under Divisions 22, Contractor shall submit the attached form, or similar form including the same information, to the Architect, with copy to United Engineering Group. Contractor shall include proposed solution in the indicated space on the form.

1.8 REFERENCES

- A. The Contractor shall comply with all laws, ordinances, and regulations of all authorities having jurisdiction, including those of all applicable city, county, state, federal and public utility entities. The Contractor shall obtain all licenses, permits, etc. and shall pay all associated connection fees, tapping fees, inspection fees, etc. This cost shall be included in the contract price.
- B. The publications listed below form a part of this specification. All publications shall be the latest edition with Amendments as adopted by the authority having jurisdiction. The minimum standard of work under this contract shall be in accordance with the following model building codes:
 - 1. North Carolina State Building Code:
 - a. Building, 2018 edition
 - b. Plumbing, 2018 edition
 - c. Mechanical, 2018 edition
 - d. National Electric Code, 2018 edition
 - e. Fire Prevention, 2018 edition
 - f. Fuel Gas, 2018 edition
 - g. Energy Conservation Code, 2018 edition
- C. The minimum design and construction parameters of the work shall be in accordance with the following standards:

1. AABC - National Standards for Total System Balance.
2. Air-Conditioning and Refrigeration Institute:
 - a. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.
 - b. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.
3. American Bearing Manufacturers Association:
 - a. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
4. American National Standards Institute:
 - a. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - b. ANSI S1.4 - Sound Level Meters.
 - c. ANSI S1.8 - Reference Quantities for Acoustical Levels.
 - d. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.
 - e. ANSI Z21.10.1 - Gas Water Heaters Vol. I Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less.
 - f. ANSI Z21.10.3 - Gas Water Heaters - Vol. III Storage, with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous Water Heaters.
 - g. ANSI Z21.15 - Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
 - h. ANSI Z21.22 - Relief Valves for Hot Water Supply Systems.
 - i. ANSI Z124.1 - Plastic Bathtub Units.
 - j. ANSI Z124.2 - Plastic Shower Units.
 - k. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.
5. American Society of Mechanical Engineers:
 - a. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - b. ASME A112.6.1 - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
 - c. ASME A112.14.1 - Backwater Valves.
 - d. ASME A112.14.3 - Grease Interceptors.

- e. ASME A112.14.4 - Grease Removal Devices.
- f. ASME A112.18.1 - Plumbing Fixture Fittings.
- g. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
- h. ASME A112.19.2M - Vitreous China Plumbing Fixtures.
- i. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
- j. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
- k. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.
- l. ASME A112.21.1 - Floor Drains.
- m. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- n. ASME B16.3 - Malleable Iron Threaded Fittings.
- o. ASME B16.4 - Gray Iron Threaded Fittings.
- p. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- q. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- r. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
- s. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- t. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
- u. ASME B31.1 - Power Piping.
- v. ASME B31.5 - Refrigeration Piping.
- w. ASME B31.9 - Building Services Piping.
- x. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
- y. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
- z. ASME PTC 25 - Pressure Relief Devices.
- aa. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

- bb. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
6. American Society of Sanitary Engineering:
- a. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
 - b. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
 - c. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
 - d. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
 - e. ASSE 1019 - Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.
 - f. ASSE 5013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers (RP) and Reduced Pressure Fire Protection Principle Backflow Preventers (RFP).
7. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
- a. ASHRAE Handbook - HVAC Applications.
 - b. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - c. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
8. ASTM International:
- a. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.
 - b. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. ASTM A74-09 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 - d. ASTM A135/A135M-06 - Standard Specification for Electric-Resistance-Welded Steel Pipe
 - e. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - f. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

- g. ASTM A395 - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- h. ASTM A536 - Standard Specification for Ductile Iron Castings.
- i. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
- j. ASTM A795/A795M-08 - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
- k. ASTM B32 - Standard Specification for Solder Metal.
- l. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
- m. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
- n. ASTM B75 - Standard Specification for Seamless Copper Tube.
- o. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- p. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- q. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
- r. ASTM B302 - Standard Specification for Threadless Copper Pipe.
- s. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
- t. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- u. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- v. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- w. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- x. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- y. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

- z. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- aa. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- bb. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- cc. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- dd. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
- ee. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- ff. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
- gg. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- hh. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- ii. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- jj. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- kk. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor
- ll. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- mm. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- nn. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- oo. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameters.
- pp. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- qq. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.

- rr. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- ss. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- tt. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- uu. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
- vv. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
- ww. ASTM D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
- xx. ASTM D2662 - Standard Specification for Polybutylene (PB) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
- yy. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- zz. ASTM D2666 - Standard Specification for Polybutylene (PB) Plastic Tubing.
- aaa. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- bbb. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
- ccc. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
- ddd. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- eee. ASTM D3000 - Standard Specification for Polybutylene (PB) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- fff. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- ggg. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- hhh. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

- iii. ASTM D3262 - Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
- jjj. ASTM D3309 - Standard Specification for Polybutylene (PB) Plastic Hot- and Cold-Water Distribution Systems.
- kkk. ASTM D3517 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe.
- lll. ASTM D3754 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe.
- mmm. ASTM D3840 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Non-pressure Applications.
- nnn. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.
- ooo. ASTM E1 - Standard Specification for ASTM Thermometers.
- ppp. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
- qqq. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- rrr. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- sss. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
- ttt. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
- uuu. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- vvv. ASTM F437 - Standard Specification for Threaded Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80.
- www. ASTM F438 - Standard Specification for Socket-Type Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40.
- xxx. ASTM F439 - Standard Specification for Socket-Type Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80.
- yyy. ASTM F441/F441M - Standard Specification for Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80.
- zzz. ASTM F442/F442M - Standard Specification for Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe (SDR-PR).

- aaaa. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - bbbb. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe and Fittings.
 - cccc. ASTM F628 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core.
 - dddd. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - eeee. ASTM F845 - Standard Specification for Plastic Insert Fittings for Polybutylene (PB) Tubing.
 - ffff. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe.
 - gggg. ASTM F1282 - Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe.
 - hhhh. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
9. American Welding Society:
- a. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 - b. AWS D1.1 - Structural Welding Code - Steel.
 - c. AWS D1.2 - Structural Welding Code--Aluminum.
 - d. AWS D1.4 - Structural Welding Code--Reinforcing Steel.
10. American Water Works Association:
- a. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - c. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3-inches through 48-inches, for Water and Other Liquids.
 - d. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - e. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

- f. AWWA C651 - Disinfecting Water Mains.
 - g. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
 - h. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
 - i. AWWA C702 - Cold-Water Meters - Compound Type.
 - j. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
 - k. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.
 - l. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in., for Water Service.
 - m. AWWA C950 - Fiberglass Pressure Pipe.
 - n. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
11. Cast Iron Soil Pipe Institute:
- a. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - b. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
12. FM Global:
- a. FM - Approval Guide - A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
13. International Electrical Testing Association:
- a. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
14. Intertek Testing Services (Warnock Hersey Listed):
- a. WH - Certification Listings.
15. Manufacturers Standardization Society of the Valve and Fittings Industry:
- a. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - b. MSS SP 67 - Butterfly Valves.

- c. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - d. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 - e. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - f. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 - g. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 - h. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
 - i. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 - j. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
16. National Electrical Manufacturers Association:
- a. NEMA MG 1 - Motors and Generators.
 - b. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
17. National Fire Protection Association:
- a. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.
 - b. NFPA 54 - National Fuel Gas Code.
 - c. NFPA 58 - Liquefied Petroleum Gas Code.
 - d. NFPA 70 - National Electrical Code
 - e. NFPA 72 - National Fire Alarm Code
 - f. NFPA 99 - Standard for Health Care Facilities.
18. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
19. Plumbing and Drainage Institute:
- a. PDI WH201 - Water Hammer Arrester Standard.
20. Underwriter Laboratories, Inc.:
- a. UL 263 - Fire Tests of Building Construction and Materials.
 - b. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

- c. UL 842 - Valves for Flammable Fluids.
 - d. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - e. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - f. UL - Fire Resistance Directory.
21. United States Department of Energy:
- a. DOE 10 CFR - Uniform Test Method for Measuring the Energy Consumption of Furnaces.

1.9 SUBMITTALS

- A. Section 220502 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. The Contractor shall submit Certificates of Compliance for the following:
 - 1. Schedule of UL listed through penetration assemblies

1.10 ELECTRICAL EQUIPMENT

- A. Refer to Section 220503 of this manual for the requirements relating to electrical equipment.

1.11 CONTROL WIRING

- A. Refer to Section 220503 of this manual for the requirements relating to wiring.

1.12 QUALITY ASSURANCE

- A. The Contractor shall coordinate his work with that of the other trades. Where interference with other trades occurs, the Contractor shall present his solutions to the Professional. The Professional shall make the final decision regarding changes to be made in the work.
- B. The Contractor shall thoroughly familiarize himself with all specifications and drawings for the project so that he clearly understands his responsibility in relationship to the work to be performed. The Contractor shall plan and perform his work so as to permit the use of the building at the earliest possible date.
- C. The Contractor shall guarantee all work, materials and equipment, furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of the Owner's final acceptance. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.
- D. The Contractor shall expressly and completely follow all manufacturers' instructions required for validation of the manufacturer's warranty agreement including but not limited to service,

maintenance and adjustments of the equipment.

- E. The Contractor is responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the contract documents.
- F. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- G. 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.
- H. Electrical Characteristics for Fire-Suppression 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.

1.13 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and tag numbering.
 - 1. Changes from the contract drawings necessary to coordinate the work with other trades, to conform to the building conditions or to conform to the rules and regulations of authorities having jurisdiction shall be made only after obtaining written permission from the Professional.
 - 2. The Contractor shall keep a record of construction changes and deviations from the original contract drawings. All changes shall be recorded on a separate set of prints, which shall be kept at the job site specifically for that purpose. The record shall be made immediately after the work is completed. Documentation shall include the following:
 - a. Location and elevation of new and existing utility lines.
 - b. Points of connection to existing utility lines.
 - c. Changes in pipe routing location.
 - d. Valve locations.
 - e. Equipment locations, etc.
 - f. Actual capacities and values of equipment provided as indicated in equipment schedules

3. The marked up record set of drawings shall be delivered to the Professional before final acceptance of the fire protection contract work.
4. Operation and Maintenance Data: Submit spare parts lists.

1.14 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. Maintain one copy of each document on site.

1.15 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience approved by manufacturer.

1.16 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.
- C. The Contractor is responsible to verify the location of any and all existing underground utilities in the vicinity of his work. When it has been indicated that these utilities are to remain in place, the Contractor shall provide adequate means of support and protection during excavation operations.
- D. Before ordering any equipment and material, or performing any work, the Contractor shall verify all measurements and dimensions at the job site. The Contractor is responsible for the correctness of this information.

- E. No extra compensation will be considered based on differences between actual dimensions and measurements and those indicated on the drawings.
- F. Any differences identified by the Contractor shall be submitted to the Professional for consideration before proceeding with the work.

1.17 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Deliver and store valves in shipping containers, with labeling in place.
- C. 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.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.18 COORDINATION

- A. The Contractor shall coordinate his work with that of the other trades. Where interference with other trades occurs, the Contractor shall present his solution to the Professional. The Professional shall make the final decision regarding changes to be made in the work.
- B. The Contractor shall thoroughly familiarize himself with all specifications and drawings for the project so that he clearly understands his responsibility in relationship to the work to be performed. The Contractor shall plan and perform his work so as to permit the use of the building at the earliest possible date.
- C. The Contractor shall guarantee all work, materials and equipment furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of the Owner's final acceptance, or as indicated in the General Conditions. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.
- D. The Contractor shall expressly and completely follow all manufacturers' instructions required for validation of the manufacturer's warranty agreement including but not limited to service, maintenance and adjustments of the equipment.
- E. The Contractor is responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the contract documents.
- F. Prepare coordination drawings at a scale of $\frac{1}{4}'' = 1'-0''$ or larger, detailing major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work. The Mechanical Contractor will administer the effort of coordination between various trades. The Plumbing Contractor will use the coordination

drawings prepared by the Mechanical Contractor to show equipment and materials for coordination between trades. The coordination drawings will be prepared before installation of any plumbing, sprinkler, mechanical or electrical work and will be shown as a task on the Project Schedule to be prepared by the General Contractor.

- G. 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.
- H. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- I. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

1.19 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Refer to individual Division 22 Sections for specific materials and/or products.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 Sections for pipe, tube, and fitting materials and joining methods.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 Sections for special joining materials not listed below.

2.3 MECHANICAL SLEEVE SEALS

- A. Refer to Section 221104.

2.4 SLEEVES

- A. Refer to Section 221104.

2.5 ESCUTCHEONS

- A. Refer to individual Division 22 Sections for material requirements.

2.6 GROUT

- A. Refer to individual Division 22 Sections for material requirements.

PART 3 - EXECUTION

3.1 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, stamped-steel type and set screw.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-

- brass finish.
- g. Retain subparagraph above or first subparagraph below.
 - h. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
2. Existing Piping: Use the following:
- a. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - b. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
 - c. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - d. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - e. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate 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 and concrete floor and roof slabs.
- P. 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 ¼-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 "Joint Sealants" for materials and installation.

Q. 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.

R. 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.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stop materials. Refer to Division 07 Section "Penetration Fire-stopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 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 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 Non-pressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
 - 7. Plastic Pressure Piping, Gasketed Joints: Join according to ASTM D 3139.

8. Plastic Non-pressure Piping, Gasketed Joints: Join according to ASTM D 3212.
9. Plastic-Piping Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.

3.3 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.
 2. Install flanges, in piping NPS 2½ 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.

3.4 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.

3.5 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.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4-inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 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.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 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 22501

SECTION 220502 – PLUMBING SHOP DRAWINGS AND SUBMITTALS, SUBSTITUTIONS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. All catalog data, shop drawings, calculations and certificates of compliance shall be submitted as a single package. Failure of the Contractor to provide a complete submittal package may result in a delay in processing time. All such delays to the project resulting from the Contractor's failure to provide submittals at one time will be the responsibility of the Contractor.

1.2 DEFINITIONS

- A. Shop Drawings: Project shop drawings and other data prepared specifically for fulfillment of the project requirements. Shop drawings include fabrication, layout, setting, installation, coordination and similar drawings and diagrams, and include performance data associated therewith, including weights, capacities, speeds, outputs, consumption, efficiencies, voltages, amperages, cycles, phases, noise levels, operating ranges, and similar information.
- B. Samples: Units of typical work, materials, or equipment items, showing the workmanship, pattern, trim and similar qualities proposed for the work to be provided, as designated.
- C. Manufacturer's Data: Product manufacturer's standard printed product information, including promotional brochures, product specifications, installation instructions and diagrams, statements of compliance with standard performance charts or curves, and similar information concerning the standard portions of the manufacturer's products.
- D. Test Reports: Specific reports prepared by independent testing laboratories and others, showing the results of specified testing on either the material/equipment provided or on identical material/equipment, and on installed electrical systems.
- E. Industry Standards: Printed copies of the current standards recognized in the industry. Current means the latest issue as of the date of these specifications, unless otherwise indicated; within the text of these specifications the date-suffix frequently shown with identification numbers has been omitted.
- F. Manufacturer's Product Warranties: Manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the Manufacturer, when and if the product fails within certain operational conditions and time limits.
- G. Operating Instructions: The written instructions by the manufacturers, fabricators, or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation, control and shut-down of each operating item of the equipment and each electrical system.
- H. Maintenance Manuals: The compiled information provided for the Owner that certain acts of

restitution will be performed when and if certain portions of electrical work fail within certain operational conditions and time limits.

1.3 SUBMITTAL FORM AND PROCEDURES:

- A. General: Comply with Division 1 requirements for identification, quantities processing, scheduling, and similar general requirements, except as otherwise indicated. Submittals shall be complete, in one package, clearly identified and cross-referenced to the appropriate specification section defining the submitted item. Partial submissions will not be addressed. The Contractor is responsible for any delays caused by incomplete submittal packages.
- B. Submittal Tracking: The Contractor shall refer to 22 05 02 - Table A for a listing of the required submittals. The Schedule shall be included as part of his submission with those portions of the schedule for which he is responsible filled out. The Schedule will be used to track the submittal through the review process.
- C. Quantities: Provide quantities as listed in the General Conditions or as otherwise indicated in the Division 22 Specifications.
- D. Presentation: Submittals shall be assembled in three ringed binders with each specification section separated by a tab on which the specification section is noted. The submittals shall be clearly marked indicating which specific item is being considered and all its related information. Submittals not complying with these requirements are subject to being returned without being reviewed.
- E. Substitutions: Plumbing submittals are not opportunities for gaining acceptance of substitutions. Where three or more manufacturers are specified by name, or by catalog reference, Contractor shall select for use any of those so specified.
- F. Should the Contractor desire to substitute another manufacturer's equipment for one specified by name, the contractor shall apply in writing at least ten (10) days prior to bid date for such permission. He shall provide supporting data and samples for Engineers consideration. No substitution shall be made for any material, article, or process required under the contract unless approved by the Engineer.
- G. Any time that is required by the Engineer for a request to review submittals for substitute equipment after the award of bids will be billed to the contractor at the Engineers current hourly billing rate. The Engineers review time will be billed to the contractor whether the proposed substitution is accepted or rejected.
- H. Operating Instructions: The written instructions by the manufacturer, fabricator, or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation.
- I. Response to Submittals: Where standard product data have been submitted in fulfillment of project requirements, it is recognized that the submitter has already determined that the products fulfill the specified requirements, and that the submittals are for the Architects' or Engineers' information only but will be returned without action where observed to be non-complying with the requirements. Where uniquely prepared information is submitted, it is recognized to represent the preparer's interpretation or solution to the specified requirements, subject to the Architects', or Engineers' concurrence and appropriate action as indicated in Division 1.

- J. Shop Drawings and Samples: After checking and verifying all field measurements, the Contractor shall submit to the Engineer for review, in accordance with the accepted schedule of shop drawings submissions, copies of all shop drawings, which shall have been checked by and stamped with the approval of the Contractor and identified as the Engineer may require. The data shown on the shop drawings shall be complete with respect to dimensions, design criteria, materials of construction and the like to enable the Engineer to review the information as required.
- K. The Contractor shall also submit to the Engineer for review, with such promptness as to cause no delay in work, all samples required by the Contract Documents. All samples shall have been checked by and stamped with the approval of the Contractor, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which intended.
- L. At the time of each submission, the Contractor shall in writing call the Engineer's attention to any deviations that the shop drawings or sample may have from the requirements of the Contract Documents.
- M. No work requiring a shop drawing or sample submission shall be commenced until the submission has been reviewed by the Engineer. A copy of each shop drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer.
- N. The Engineer's review of shop drawings or samples shall not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has in writing called the Engineer's attention to such deviation at the time of submission and the Engineer has given written approval to the specific deviation, nor shall any review by the Engineer relieve the Contractor from responsibility for errors or omissions in the shop drawings.
- O. The Contractor's shop drawing stamp shall indicate that the shop drawings have been checked for conformity to the Contract Documents and appropriate means have been taken to insure that the material and /or equipment will fit into the space available. Shop drawings will be returned without review if the submittals do not have the Contractor's stamp or the submittals have not been reviewed by the Contractor.
- P. The Engineer's review of shop drawings is for general conformance with design concept only. The Contractor is responsible for all quantities, dimensions and coordination of the work of all trades. Corrections or comments made on the shop drawing during this review do not relieve the contractor from compliance with requirements of the contract documents. The Contractor is responsible for selecting fabrication processes and techniques of construction and for performing all work in a safe and satisfactory manner.
- Q. The Contractor shall stamp the shop drawings and submittals and verify by his/her signature that the shop drawings and submittals have been checked for compliance with the contract documents.
- R. The Contractor shall provide TABLE A as a cover letter with the submittals. The "Date Submitted" column shall be filled in by the Contractor. The remaining three columns are for the Engineer's use.

1.4 GENERAL SUBMITTAL REQUIREMENTS:

- A. Applicability: Wherever it is indicated that a shop drawing, sample, manufacturer's brochure, certification, test, copy of standard operating instruction, manual, extra stock, guarantee or warranty is required, the appropriate submittal is required regardless of whether it is specified as a "submittal"; the Architects' or Engineers' decision shall be final.

1.5 SUBSTITUTIONS:

- A. Substitutions: Plumbing submittals are not opportunities for gaining acceptance of substitutions. Where three or more manufacturers are specified by name, or by catalog reference, Contractor shall select for use any of those so specified.
- B. Should the Contractor desire to substitute another manufacturer's equipment for one specified by name, the Contractor shall apply in writing at least ten (10) days prior to bid date for such permission. He shall provide supporting data and samples for Engineers consideration. No substitution shall be made for any material, article, or process required under the contract unless approved by the Engineer.
- C. Any time that is required by the Engineer for a request to review submittals for substitute equipment after the award of bids will be billed to the Contractor at the Engineers current hourly billing rate. The Engineers review time will be billed to the Contractor whether the proposed substitution is accepted or rejected.

1.6 OPERATION AND MAINTENANCE MANUALS

- A. Submit two (2) sets of 8½" x 11" text sixty (60) days prior to operator training/pre-final inspection bound in three D side-ring capacity expansion binders with durable plastic covers for review by the Professional.
- B. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on thirty (30) pound white paper.
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Professional, Contractor, Subcontractors, and equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions arranged by system or process flow and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a) Significant design criteria.
 - b) List of equipment.
 - c) Parts list for each component.

- d) Maintenance instructions for equipment and systems.
 - e) Maintenance instructions for finishes, including recommended cleaning methods and materials and Operating instructions.
 - f) Special precautions identifying detrimental agents.
 - g) Special Requirements of other sections of this specification noted to be included in the operating and maintenance manual.
3. Part 3: Project documents and certificates, including the following:
- a) All approved Submittals
 - b) Certificates of Compliance
 - c) Photocopies of warranties and bonds
 - d) Material safety data sheets
- E. Submit five (5) copies of completed volumes in final form fifteen (15) days prior to owner training. These copies will include Professional's previous review comments.
- F. Submit eight final volumes revised, within ten (10) days after pre-final observation.

END OF SECTION 220502

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SECTION 220503 – COMMON ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.

1.2 SUMMARY

- A. Section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- B. Related Sections:
 - 1. Division 26 - Grounding and Bonding for Electrical Systems.
 - 2. Division 26 - Identification for Electrical Systems.

1.3 REFERENCES

- A. Refer to Section 220501 for complete listing of references.

1.4 SUBMITTALS

- A. Section 220502 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.
- C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and

finish.

- C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
- D. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 WIRING

- A. All wiring and conduit shall be in accordance with the requirements of Division 26.
- B. Low voltage control wiring shall be not less than #18 gauge copper wire run in metallic conduit.
- C. All control wiring under 30 Volts shall be considered low voltage wiring regardless of Class.

2.2 MOTORS

- A. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with standards of ASA-C50 and conform thereto for insulation resistance and dielectric strength. Motors shall be provided with conduit terminal box, adequate starting and protective equipment as specified or required. Size shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and at least shall be the horsepower indicated or specified. Motors shall be selected for quiet operation.
- B. Motors less than 3/4-HP shall be single phase, PSC/capacitor start-induction run, open type, splash proof. Motors 3/4-HP and larger shall be induction, open 3-phase multi tap unless otherwise indicated. Voltage for 3-phase motors is noted in schedules. Coordinate electrical service requirements with Electrical Contractor.
- C. Motors shall be provided with overload protection. On 3-phase motors overload protection shall be in the starters. Single-phase motors shall have built-in thermal overload protection.
- D. Motors shall be sufficient size for the duty to be performed, not less than that indicated on the drawings, and shall not exceed their full rated load when the driven equipment is operating at specified capacity under the most severe conditions likely to be encountered. All motors shall be for continuous duty classification based on 40 degrees C ambient temperature unless otherwise indicated.
- E. Motors shall be rated "energy efficient" based on NEMA Table 12-6C. Efficiency shall be determined in accordance with IEEE Standard 112, method B.
- F. Motor efficiency shall comply with North Carolina State Building Code – Electrical – 2008.
- G. All vertically mounted motors shall be provided with thrust bearings.
- H. Motors shall be open drip proof (ODP) for indoor use where satisfactorily housed, guarded drip proof when exposed to contact by employees or building occupants, TEFC (totally enclosed fan

cooled) for outdoor use.

- I. Motors that are specified to cycle on and off automatically under control of a device shall be capable of making starts as frequently as the device may demand. Other motors shall be capable of being started 4 times per hour without damage.
- J. All 3-phase motors shall be provided with lugs.
- K. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque. Class "B" insulation shall be provided.
 - 1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
 - 2. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
 - 3. Service Factor: The service factor shall be at least 1.15 for poly phase motors and 1.35 for single phase motors.
- L. All motors 40 hp and larger shall be provided with reduced voltage starters.

2.3 STARTERS AND CONTROLLERS

- A. Controllers and Control: Where controllers and controls are specified to be provided by the Contractor, they shall conform to the requirements specified below:
 - 1. Controllers shall conform to adopted standards and recommended practices of the Industrial Control Standards of National Electrical Manufacturer's Association and the standard for Industrial Control Equipment of the Underwriters' Laboratories, Inc. Motors 93 W (1/8-HP) or larger and shall be provided with thermal overload protection. Manually reset type. Overload protective device shall be provided, mounted in separate enclosure. Single or double-pole tumbler heavy duty switches may be used as manual controllers for motors of 186 W (1/4-HP) or less in rating. Manual controllers for motors larger than 186 W (1/4-HP) shall be designed for purpose and shall have horsepower rating adequate for motor. Two speed motors shall have two (2) winding type controllers unless otherwise specified.
 - 2. Combination magnetic starter shall be full voltage, across the line type with under-voltage release for manual or automatic operation and shall break all phases on 3-phase starters for motors up to 40-HP. Starters shall be provided with start-stop pushbuttons mounted on cover unless controlled by hand-off-automatic (HOA) device. Hand-off-automatic device shall not be wired to override safety device interlocks on starter and shall be mounted on the starter or if adjacent mounted remotely, provide test start pushbutton on starter. All auxiliary contacts required for interlocking purposes shall be furnished and installed by the Contractor furnishing the starter. All starters not included in motor control centers shall be provided by Division 22.
 - 3. Manual starters shall be provided with a manually operated trip free switch, horsepower rated with a separate fused disconnect.

4. Contractor providing the starters shall be responsible for all motors to be protected with proper size heater or thermal elements. All starters and enclosures shall be NEMA Standard, Type 1 unless otherwise specified. In wet locations, enclosures shall be NEMA 3R.
5. All starters and pushbutton stations shall be provided with labels as specified under identification designating service for which starter is used. Plate shall be firmly attached to starter or wall mounted adjacent to the starter.
6. All cabinets provided for the installation of motor starters, control transformers, relays, and appurtenant items shall be provided with gravity or forced ventilation at the option of the manufacturer. Openings shall be placed at bottom and top of the cabinet or high-low in the door if recessed and of sufficient size to limit the temperature rise through the enclosure or ambient compensated heater elements shall be provided.
7. All controllers and starters shall be rated for the same voltage as the motor which it serves. If the voltage is not indicated on the Plumbing drawings, the Contractor shall provide the units at the voltage listed on the electrical drawings.
8. Provide built-in 120-volt control circuit transformer, fused from line side, where service voltage exceeds 240 volts.
9. Provide externally operated manual reset.
10. Motor connections shall be in waterproofed, sealtite flexible conduit, maximum length of 457 mm (18"), except where plug-in electrical cords are specifically indicated.

2.4 DRIVES

- A. Machinery drives shall be provided for all power-driven equipment specified in this Division.
- B. Drives shall be V-belt and shall be selected to overcome the starting inertia of the equipment without slippage but in no case rated for less than 150% of the full motor load. Drives which require two (2) belts or less shall be adjustable. Drives which require three (3) or more belts shall be fixed sheave unless noted otherwise. Contractor shall provide an initial drive package sized for specified conditions and shall include in his proposal the cost of an additional pulley and belt for each fixed sheave drive.
- C. Adjustable type sheaves, shall be selected such that the scheduled speed of the driven equipment is near the midpoint in the adjustment range of the sheave.
- D. Fixed type sheaves shall be changed in size once during the balancing period if necessary to achieve proper air quantities.
- E. Sheaves shall be machined cast iron.

2.5 SOURCE QUALITY CONTROL

- A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and

current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned motors
- B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing motors to remain or are to be reinstalled.

3.2 INSTALLATION

- A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- B. Install engraved plastic nameplates in accordance with Division 26.
- C. Ground and bond motors in accordance with Division 26.

3.3 WIRING

- A. Regardless of voltage, furnish and install all control and instrumentation wiring, all interlock wiring and equipment control wiring for the equipment furnished.
- B. Electrical Contractor will furnish and install all wiring except as noted below. Electrical Contractor will furnish and install all power wiring complete from power source to the disconnect. Plumbing Contractor will furnish and install all disconnects and starters not factory mounted on equipment and not located in motor control centers. Plumbing Contractor shall wire from the disconnect to the motor. When not provided under Division 26, controllers and controls shall be provided by the Plumbing Contractor.
- C. Check with Electrical Contractor on service outlets provided to determine that service, circuit protection, switches and wiring provided are of adequate size to meet Code requirements for equipment provided. Discrepancies shall be brought to the attention of the Engineer before work is installed. Cost for changes not so noted shall be at the expense of this Contractor. Electrical cost increase due to equipment substitution of different electrical characteristics shall be this Contractor's expense.
- D. Provide necessary electrical data for all equipment to the Electrical Contractor for proper coordination.
- E. Control and interlock wiring shall be run in conduit.
- F. Provide control circuit disconnect for all motor starters as required by Section 430-74 of NEC.
- G. Unless otherwise noted or specified, all low voltage and line voltage control and instrumentation wiring and devices for equipment furnished under Division 22 shall be provided as part of this Division 22. Control wiring is considered to be the portion of the wiring which

carries the electric signal directing or indicating the performance of a starter, relay, or contactor generally installed between starters, indicators, and remote-control devices.

- H. Examine the drawings, and in cooperation with the Electrical Trade, confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping to be no closer than 24-inches from the vertical line to electric motor controllers, switchboards, panel boards, or similar equipment. If the vertical line is less than 24-inches, the installation of piping shall be relocated.

3.4 FIELD QUALITY CONTROL

- A. Division 01- 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 7.15.

END OF SECTION 220503

SECTION 220504 - DOMESTIC WATER SYSTEM AND SPECIALTIES

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 01 are a part of these Specifications.

1.2 SECTION INCLUDES

- A. Work in this Section includes the following:
 - 1. Cleanouts
 - 2. Floor Drains
 - 3. Hose Bibbs
 - 4. Wall Hydrants
 - 5. Backflow Prevention Devices
 - 6. Water Hammer Arrestors
 - 7. Pressure Gauges
 - 8. Thermometers
 - 9. Domestic Water Pressure Regulating Valves

1.3 RELATED SECTIONS

- A. All sections of the Project Manual apply to this section.

1.4 SUBMITTALS

- A. Submittals shall be in accordance with Section 016000
- B. The Contractor shall submit manufacturer's catalog data for the following:
 - 1. Cleanouts
 - 2. Floor Drains
 - 3. Hose Bibbs

4. Wall Hydrants
 5. Backflow Prevention Devices
 6. Water Hammer Arrestors
 7. Pressure Gauges
 8. Thermometers
 9. Domestic Water Pressure Regulating Valves
- C. The Contractor shall submit Operation and Maintenance Data for the following:
1. Backflow Prevention Devices
 2. Domestic Water Pressure Regulating Valves

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Finished Floor Cleanouts: Coated cast-iron body, taper thread bronze plug, scoriated secured nickel bronze top. Cleanout shall have adjustable housing.
1. Acceptable Manufacturers:

Josam	56010-22
Jay R. Smith	4023
Wade	W-6000-1
Zurn	ZN-1400-BP
- B. Tile Floors Cleanouts: Coated cast-iron body, taper thread bronze plug, with square top recessed for tile. Cleanout shall have adjustable housing.
1. Acceptable Manufacturers:

Josam	56010-22-12
Jay R. Smith	4163
Wade	W-6000-TS
Zurn	ZN-1400-BP-TX
- C. Terrazzo Floors: Coated cast-iron body, taper thread bronze plug, with nickel bronze round top recessed for terrazzo. Cleanout shall have adjustable housing.
1. Acceptable Manufacturers:

Josam	56010-13-1
Jay R. Smith	4183

Wade	W-6000-U
Zurn	Z-1400-BP-Z

D. Wall Cleanouts: Round stainless steel wall access cover with center screw and recessed bronze tapped plug. Provide cleanout with threaded coated cast iron cleanout tee.

1. Acceptable Manufacturers:
Josam 58790
Jay. R. Smith 4472
Wade W-8480R-8590E
Zurn ZANB-1468

E. Exposed Piping Cleanouts: Recessed bronze tapped plug in threaded cast-iron cleanout tee.

1. Acceptable Manufacturers:
Josam 58890
Jay R. Smith 4472
Wade W- 8480R-8590E
Zurn ZANB-1468

2.2 FLOOR DRAINS

A. Floor Drains

1. See schedules for types and basis of design model numbers.
2. Coated cast-iron floor drain. Outlet type shall be suitable for the type of piping system provided. Provide floor drain with P-trap
3. Acceptable Manufacturers:
Josam
Jay R. Smith
Wade
Zurn

B. Indirect Waste (Hub Drains)

1. See schedules for types and basis of design model numbers.
2. Acceptable Manufacturers:
Josam
Jay R. Smith
Wade
Zurn

2.3 HOSE BIBBS

A. Hose Bibb

Angle pattern hose bibb consisting of a brass body, vacuum breaker-backflow preventer with 3/4 inch male hose thread nozzle, tee-handle and 3/4 inch copper water tube inlet.

1. Acceptable Manufacturers:

Chicago	387RCF
Wolverine Brass	Encore
Woodford	Model 24C

2.4 WALL HYDRANTS

A. Wall Hydrant (Non-Freeze in Wall Box)

Concealed type, automatic draining wall hydrant consisting of a cast brass wall box and door with chrome finish, vacuum breaker-backflow preventer with 3/4-inch male hose thread nozzle, stainless steel operating stem and 3/4-inch copper water tube inlet. A loose tee key shall be furnished with each wall hydrant.

1. Acceptable Manufacturers:

Woodford	B65
Josam	71000-96
Jay R. Smith	5509QT
Wade	W-8600-175
Zurn	Z-1300
2. Acceptable Manufacturers:

Josam	71200
Jay R. Smith	5609
Wade	W-8600
Zurn	Z-1310
Woodford	65

2.5 BACKFLOW PREVENTION DEVICES

- A. Backflow prevention devices shall be installed where shown on the drawings and conform to the type required by the local water authority.
- B. Units shall be supported in accordance with manufacturer's recommendations.
- C. Reduced Pressure Backflow Prevention Device - ANSI/ASSE 1013; bronze body with bronze and plastic internal parts and stainless-steel springs; two (2) independently operating, spring loaded check valves with replaceable seats; diaphragm type differential pressure relief valve

located between check valves; non-threaded vent outlet; assembled with two (2) gate valves, strainer, and test cocks.

- D. Double Check Valve Assemblies - ANSI/ASSE 1015; corrosion resistant internal parts and stainless-steel springs; two independently operating check valves, assembled with two (2) gate valves, strainer, and test cocks.
- E. Manufacturer and model number shall be approved by the local utility company.
- F. Acceptable Manufacturers:
Conbraco

Febco

Watts

Wilkins.

2.6 WATER HAMMER ARRESTORS

- A. Water Hammer Arrestors shall be of Type "L", Type "K" copper or stainless-steel bellows or piston type construction conforming to ASME A112.26.1M, ASSE 1010 or PDI WH-201. ASME A112.23.1M sizes A through F and PDI-WH201 sizes A through F. Neoprene bellows not allowed.
- B. Acceptable Manufacturers:
PPP, Inc. Series SWA or SC

Sioux Chief Series 650

Jay R. Smith Hydrotrol

Zurn Shoktrol

2.7 PRESSURE GAUGES

- A. 4-1/2-inch dial, liquid filled, stainless steel and phosphor bronze movement, gauge cock and throttling device. Pressure range shall be 0 psi to 150 psi.
- B. Acceptable Manufacturers:

H.O. Trerice Co. 450LFB
Weiss Instruments LF4UGY1
Weksler Instruments AY14-2

2.8 THERMOMETERS

- A. 4-inch mercury type. Temperature range shall be 0oF to 200oF.
- B. Acceptable Manufacturers:

H.O. Trerice Co. M80742

Weiss

Weksler

2.9 DOMESTIC WATER PRESSURE REGULATING VALVES (PRV)

- A. Pressure regulating valves shall be direct acting piston type, bronze body and bell housing, reinforced neoprene diaphragm, renewable model seats, strainer, and union connection.
- B. Water service applications - 400 psig rated at 160 degrees F. Each regulator shall have a "Y" type bronze strainer, spring range shall be as required for application. Basis of design shall be Wilkins series 500 YSBR. The Contractor shall field assemble regulating stations including bypass piping with shutoff valve and pressure gauge on discharge side of manifold. Each regulating valve shall be isolated with two full port shutoff valves. Field adjust PRV's to maintain required outlet pressure, (maximum of eighty (80) psi or the minimum booster pump suction pressure if it is greater than eighty (80) psi). Where multiple PRV's are installed the small shall be set for ten (10) psig higher than the larger valves.
- C. Flow control or special equipment applications - rated for 300 psig at 180 degrees F, built-in thermal bypass, integral strainer, and screen. Spring range shall be as required. Provide isolation valve and union tailpiece. Field adjust outlet pressure to equipment manufacturers lowest pressure range requirement. Basis of design shall be Wilkins series 600.
- D. Acceptable Manufacturers:
 - Spence
 - Watts
 - Wilkins

PART 3 EXECUTION

3.1 INSTALLATION

- A. All materials, equipment and accessories shall be installed in strict accordance with manufacturer's recommendations.
- B. Provide isolation valves for all fixtures, equipment, and accessories.
- C. Drain piping from all backflow preventers, relief valves and vents, drain down connections, kitchen equipment, etc. shall be extended to within 2 inches of a floor sink or floor drain. Minimum piping size shall be 1-1/4" diameter.

3.2 HOSE BIBBS

- A. Install at low points of piping systems and were shown on the drawings.

3.3 WALL HYDRANTS

- A. Install minimum 24 inches above grade.

END OF SECTION 220504

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. The cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character and quality of product desired; and those equivalent products will be acceptable.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Valve Tags.
 - 3. Warning Tags.
 - 4. Stencils.
 - 5. Pipe markers.
 - 6. Ceiling markers.
- B. Related Sections:
 - 1. Division 09 - Painting and Coating: Execution requirements for painting specified by this section.

1.3 REFERENCES

- A. Refer to Section 220501 for complete listing of references.

1.4 SUBMITTALS

- A. Section 220502 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

- D. Samples: Submit two (2) of each valve tag, label, pipe marker, and ceiling marker, size used on project.
- E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Safety Sign Co.

3. Seton Identification Products

4. Brady Worldwide

2.2 EQUIPMENT NAMEPLATES

A. Product Description:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 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 2½ by ¾-inch.
6. Minimum Letter Size: ¼-inch for name of units if viewing distance is less than 24-inches, ½-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.

2.3 VALVE TAGS

A. Plastic Tags:

1. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1½-inches in diameter or 1½-inches square.
2. Fasteners: Brass beaded chain.

B. Metal Tags:

1. Brass, Aluminum, or Stainless Steel with stamped letters; tag size minimum 1½-inches in diameter or 1½-inches square with finished edges and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain.

2.4 WARNING TAGS

A. Information Tags:

1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3¼ x 5-5/8-inches with grommet and self-locking nylon ties.

2.5 SCHEDULES

- A. Typewritten letter size list of applied labels, tags and location in anodized aluminum frame or plastic laminated.
1. Equipment Nameplate Schedule: For each item of equipment to be labeled, on 8½ by 11-inch bond paper. Tabulate equipment identification number(s) and identify where equipment is located, plus the Specification Section number and title where equipment is specified.
 - a. Equipment schedule shall be included in operation and maintenance data.
 2. Valve Tag Schedules: For each piping system, on 8½ 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.
 - a. Valve-tag schedule shall be included in operation and maintenance data.

2.6 STENCILS

- A. Stencils: With clean, die-cut symbols and letters of following size:
1. Up to 2-inches Outside Diameter of Insulation or Pipe: ½-inch high letters.
 2. 2½ to 6-inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
 3. Over 6-inches Outside Diameter of Insulation or Pipe: 1¾-inches high letters.
 4. Equipment: 1¾-inches high letters.
- B. Stencil Paint: As specified in Division 09, semi-gloss enamel, colors and lettering size, conforming to ASME A13.1.

2.7 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
1. Preprinted, color-coded, with lettering indicating service, and showing flow direction.
 2. 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.
 3. Lettering Size: At least 1½-inches high.
- B. Plastic Pipe Markers:
1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:

1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Underground Pipe Markers:

1. Metal pipe: Bright colored continuously printed plastic ribbon tape, minimum 6-inches wide by 4-mil thick, manufactured for direct burial service.
2. Plastic pipe: Bright colored, continuously printed, minimum 4-mil thick, solid aluminum foil core, manufactured for direct burial service and detectable with non-ferrous metal detector.
3. Size per burial depth:
 - a. 2-inch wide tape for up to 14-inch deep burial.
 - b. 3-inch wide tape for 14 to 24-inch deep burial.
 - c. 6-inch wide tape for 24 to 36-inch deep burial.

2.8 CEILING MARKERS

A. Description: Laminated three-layer plastic with 1/8-inch minimum engraved black letters on white background or color matching lay-in ceiling grid.

1. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
2. Match description used on Equipment Label or Valve Tag.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify all piping has been insulated, painted and/or installed prior to beginning of identification installation.
- B. Coordinate pipe service and direction of flow with installing contractor.
- C. Degrease and clean surfaces to receive adhesive for identification materials.
- D. Prepare surfaces in accordance with Division 09 for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Division 09. All painting shall be done in a careful, neat and workmanlike manner, with particular care being exercised to protect building equipment and finishes. All surfaces shall be thoroughly cleaned or rust, scale, dirt, grease, dust, and like items, and sanded so as to provide a bond for new paint. All painted surfaces

under this Contract shall be finished in an acceptable manner.

- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners.
- D. Install tags using corrosion resistant chain. Number tags consecutively by location.
- E. Install underground plastic pipe marker tape below finished grade, directly above buried pipe. Install detectable utility marking tape above all non-metallic, outside pipelines.
- F. Identify water heaters, pumps, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
 - 1. In buildings where existing piping systems are modified, the new valve tag numbers and list shall be coordinated with existing valve tag numbers and lists; and, those supplied under other contracts, if applicable.
- I. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure (where applicable). Install in clear view and align with axis of piping.
 - 1. On straight runs of piping at intervals not exceeding 20-feet
 - 2. Within 2-feet of all elbows
 - 3. Within 2-feet of all piping as it passes through partitions (markers provided on both sides of partitions)
- J. Provide ceiling markers to locate valves and equipment. Above T-bar type panel ceilings locate on ceiling grid closest to equipment. At access panels locate on frame or door of access.
- K. Piping shall be color-coded and labeled according to ANSI A13.1 standards. Color chips shall be provided to the Owner for approval.
 - 1. All cold service insulated pipe (interior domestic cold water) shall have rust inhibitive prime coat applied before insulation.
 - 2. All uninsulated pipe or bare metal shall have rust inhibitive primer plus minimum two finish coats of approved color.
 - 3. Colors shall be submitted to Owner for approval. Rustoleum listed for reference only.
 - a. Natural Gas – Light yellow (Rustoleum Sun Yellow 1945)
 - b. Waste and Vent – Flat black
 - c. Cold Water – Vista or forest green

- d. Hot Water – Warm yellow (Rustoleum 1041)
- e. Sprinkler – Safety red
- f. Pipe hangers and rods – Flat black

END OF SECTION 220553

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SECTION 221101 – PLUMBING PIPING

PART 1 GENERAL

1.1 REQUIREMENTS

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 1 and 2 are a part of these Specifications.

1.2 SECTION INCLUDES

- A. Work in this Section includes the following:
 - 1. Domestic water piping
 - 2. Sanitary waste and vent
 - 3. Natural Gas Piping
 - 4. Sleeves and floor plates
 - 5. Supports, hangers, inserts and fasteners
 - 6. Valves
 - 7. Pipe identification labels
 - 8. Valve tags
 - 9. Utility marking tape

1.3 RELATED SECTIONS

- A. All sections of the Project Manual apply to this section.

1.4 SUBMITTALS

- A. Submittals shall be in accordance with Section 220105 – Shop Drawings and Submittals.
- B. The Contractor shall submit manufacturer's catalog data for the following:
 - 1. Domestic water piping
 - 2. Sanitary waste, vent and storm drain piping

3. Fuel gas piping
 4. Sleeves and floor plates
 5. Supports, hangers, inserts and fasteners
 6. Valves
 7. Pipe insulation
 8. Pipe identification labels
 9. Valve tags
 10. Utility marking tape
- C. The Contractor shall submit Certificates of Compliance for the following:
1. Schedule of UL listed through penetration assemblies
- D. The Contractor shall submit Operation and Maintenance Data for the following:
1. Valves

1.5 JOB CONDITIONS

- A. The Contractor shall verify the requirements for the gas service with the Gas Utility Company before starting work.
The Contractor shall include in his bid price the cost to obtain, furnish and install the gas meter, regulators, associated concrete pads, piping, supports and valves required by the Gas Utility Company as a condition to provide service

PART 2 PRODUCTS

2.1 DOMESTIC WATER PIPING AND TRAP PRIMER PIPING

- A. Aboveground:
- | | |
|-----------------|--|
| Piping: | Type "L" hard temper copper tubing, ASTM B88 |
| Fittings: | Cast bronze or wrought copper solder end fittings, ANSI B16.18, ANSI B16.22 |
| Fittings: | ProPress Fittings: Copper Press-Connect Fittings |
| Solder: | 95-5 tin-antimony solder, ASTM B32 for sizes up to 1-1/4 -inch |
| Brazing solder: | ASTM B260 for sizes 1-1/2-inch and larger using copper-phosphorus or copper-phosphorus-silver brazing filler material (BCuP series) in accordance with ANSI/AWS standards. |

- B. Underground (1/2-inch through 2-1/2-inches): (Water piping within the building and below the slab shall have no joints below the slab.)
Piping: Type "K" copper tubing, ASTM B88
Fittings: Cast bronze flared fittings, AWWA
- C. Underground (3-inches and larger):
Piping: Ductile Iron pressure pipe Class 52, ANSI A21.51/AWWA C151 with ANSI A21.4/AWWA C104 cement lining
Fittings: Mechanical joint ANSI A21.10/AWWA C110 with gaskets

2.2 SANITARY WASTE AND VENT PIPING

- A. Aboveground:
Piping: Cast iron, no-hub, service weight cast iron CISPI 301
Fittings: Heavy duty "No-Hub" drainage pattern type CISPI 301.
Couplings: Type 304 stainless steel Sealing sleeve with a minimum gauge 0.015 clamp assembly with a 3/8 inch worm gear tightened to a torque of 80 inch pounds conforming to ASTM C 1540 and an elastomeric sealing sleeve conforming to ASTM C564.
Clamp width – 3" wide minimum for 1½" to 4"
Clamp width – 4" wide minimum for 5" and larger
- B. Fixture Branch
Piping: Type M hard drawn copper tubing, ASTM B306
Fittings: Wrought copper drainage type fittings, ANSI B16.29 or cast copper drainage type fittings, ANSI B16.23
Solder: 95-5 tin-antimony solder, ASTM B32
Piping: Cast iron, no-hub, service weight cast iron CISPI 301
Fittings: No-hub drainage pattern type CISPI 301.
Couplings: Sealing sleeve with heavy duty ASTM A666, Type 304 stainless steel shield and clamp assembly – 0.016-inch thick minimum and torque to 80 psi.
Clamp width – 3" wide for 1 ½" to 4"
Clamp width – 4" wide for 5" and larger
Piping: Schedule 40 galvanized steel pipe, ASTM A53
Fittings: Threaded, 150 pound, malleable iron fittings, ANSI B16.3.
Do not use copper for urinal waste.
- C. Underground
Piping: Service weight, hub and spigot cast iron soil pipe, ASTM A74.
Fittings: Cast iron, hub and spigot, drainage pattern type, ASTM A74 with neoprene

compression type gaskets, ASTM C564.

- D. PVC Pipe: ASTM D1785, Schedule 80, polyvinyl chloride (PVC) material, bell and spigot style solvent sealed joint ends.
 - 1. Fittings: ASTM D2467, Schedule 80, PVC.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 Solvent cement.

- E. Drain Piping (Condensate, Relief Valve, Indirect Waste, and Backflow Preventer Drain Piping):
 - Piping: Type "M" hard temper copper tubing, ASTM B88
 - Fittings: Cast bronze or wrought copper solder end fittings, ANSI B16.18, ANSI B16.22 or ANSI B16.24
 - Solder: 95-5 tin-antimony solder, ASTM B32

2.3 NATURAL GAS PIPING

- A. Underground (polyethylene)
 - 1. Piping: SDR11 polyethylene, (PB2306/PE2405), ASTM D2513
 - 2. The Contractor shall submit a letter from the Gas Company confirming their approval of this material.
 - 3. Fittings: Heat fusion joints

- B. Underground (4-inch and larger):
 - 1. Piping: Schedule 40 black steel, ASTM A53 with polyethylene jacket, AWWA C105 or double layer, half-lapped 10 mil polyethylene tape
 - 2. Fittings: Forged steel butt welding type, ASTM A234 with polyethylene jacket, AWWA C105 or double layer, half-lapped 10 mil polyethylene tape

- C. Aboveground (2-inch and smaller):
 - 1. Piping: Schedule 40 black steel pipe, ASTM A53
 - 2. Fittings: Threaded, 150 pound malleable iron fittings, ANSI B16.3

- D. Aboveground (2½ -inch and larger):
 - 1. Piping: Schedule 40 black steel pipe, ASTM A53
 - 2. Fittings: Forged steel butt welding type, ASTM A234

- E. Unions for Pipe 2-inches and Smaller:
 - 1. Ferrous Piping: Class 150, malleable iron, threaded.
 - 2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

- F. Flanges for Pipe 2½-inches and Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Gaskets: 1/16-inch thick preformed neoprene gaskets.

2.4 SLEEVES AND FLOOR PLATES

- A. Sleeves in finished areas shall be fitted with chrome plated escutcheons sized to fit securely at the pipe or pipe insulation and shall cover the sleeve and penetration opening.
- B. Floor sleeves located in areas with automatic sprinkler protection shall have sleeves extending a maximum of 2-inches above the finish floor. Escutcheons shall accommodate the depth of the sleeve.
- C. Sleeves in Non-Rated Construction
 - 1. Interior Partitions - New Construction
 - 24-gauge galvanized sheet metal sleeve
 - Mineral wool insulation packing between sleeve and piping/piping insulation
 - 2. Floor - New Construction
 - Schedule 40 black steel sleeve with retaining collar welded to sleeve
 - Mineral wool insulation packing between sleeve and piping/piping insulation
 - 3. Slab on Grade
 - Schedule 40 black steel sleeve with retaining collar welded to sleeve
 - Expandable modular seals with molded rubber interlocking sections
 - Seal Manufacturers:
 - Thunderline Corporation
 - Metraflex Company
 - 4. Underground Foundation Wall - New Construction
 - Schedule 40 black steel sleeve with retaining collar welded to sleeve
 - Mineral wool insulation packing between sleeve and piping
 - 5. Underground Under Foundation Wall – All Construction
 - Schedule 40 black steel sleeve coated with bitumastic material
 - Mineral wool insulation packing between sleeve and piping
- D. Sleeves in Rated Construction
 - 1. Piping which penetrates rated construction shall be provided with UL listed through penetration assemblies. Assemblies shall provide protection of the through penetration equal to or greater than the construction rating. Assemblies shall be selected after determining all characteristics of the assembly including piping material and size, construction type, rating (in hours) of the required construction and fill, void or cavity materials.

2.5 SUPPORTS, HANGERS, INSERTS AND FASTENERS

- A. Provide all miscellaneous steel required for support of pipes and equipment other than steel shown on Structural Engineer's drawings.

- B. Pipe hanger design, materials, and manufacturer shall conform with the requirements defined in MSS SP58-88.
- C. The selection and spacing of pipe hangers shall comply with the data included in MSS SP69-91.
- D. All hanger materials including clevis hangers, rods, inserts, clamps, stanchions, brackets, shall have a factory applied finish of electro-plated zinc, unless noted otherwise.
- E. Hangers, clamps and supports for use on un-insulated copper piping shall be provided with inserts to isolate the copper piping from the hanger. Inserts shall be made of felt or plastic and shall be as manufactured by the hanger manufacturer.
- F. Insulated piping shall be provided with insulation shields. Hanger shall be sized to include piping diameter and insulation thickness.
- G. Hanger Materials:
1. Horizontal Sanitary, Waste and Vent Piping:
 - a. 3 inch and smaller:

B-Line	B3100
Grinnell	260
PHD	450
 - b. 4 inch and larger:

B-Line	B3102
Grinnell	590
PHD	420
 2. Horizontal Domestic Water Piping:
 - a. 2 inch and smaller:

B-Line	B3100
Grinnell	260
PHD	450
 - b. 2-1/2 inch and larger:

B-Line	B3100
Grinnell	260
PHD	450
 - c. AWWA piping:

B-Line	B3102
Grinnell	590
PHD	420
 3. Insulation Shields
 - a. All Piping:

- | | | |
|--|----------|-------|
| | B-Line | B3155 |
| | Grinnell | 168 |
| | PHD | 160 |
4. Vertical Piping (Riser Clamps):
- a. Copper Pipe (copper plated with plastic coated formed portion.):
- | | | |
|--|----------|---------|
| | B-Line | B3373CT |
| | Grinnell | CT-121C |
| | PHD | 554 |
- b. Steel Pipe:
- | | | |
|--|----------|-------|
| | B-Line | B3373 |
| | Grinnell | 261 |
| | PHD | 550 |
5. Connectors:
- a. Beam Clamps:
- | | | |
|--|----------|---------------------------|
| | B-Line | B3033, B3050, B3291-B3297 |
| | Grinnell | 88, 133, 134 or 292S. |
| | PHD | 360, 620 |
- b. Concrete inserts:
- | | | |
|--|----------|--------------|
| | B-Line | B2500, B3014 |
| | Grinnell | 282, 285 |
| | PHD | 950 |
- c. Welded beam attachments:
- | | | |
|--|----------|-------|
| | B-Line | B3083 |
| | Grinnell | 66 |
| | PHD | 900 |
- d. Piping adjacent to walls or steel columns, brackets:
- | | | |
|--|----------|--|
| | B-Line | |
| | Grinnell | No. 194, 195, or 199, depending on weight to be supported. |
| | PHD | |
- e. Base supports:
- | | | |
|--|----------|-------------------------|
| | B-Line | |
| | Grinnell | Figure No. 259, or 264. |
| | PHD | |
6. Hanger Rods:

- a. Hanger rod:
 - B-line
 - Grinnell Figure No. 140.
 - PHD
- b. Continuous threaded rod:
 - B-line
 - Grinnell Figure No. 146.
 - PHD
- c. Eye Rods:
 - B-line
 - Grinnell Figure No. 248.
 - PHD

2.6 VALVES

- A. All valves shall be products regularly produced for the specified service and rating in accordance with the manufacturer's catalog or engineering data. All valves shall be marked with the manufacturer's name or trademark. The recommended service pressure and the size, by letters and figures, cast or stamped on the body of the valve. Lead content in brass and bronze used in valves for plumbing systems shall not exceed two (2) percent.
- B. All valves shall be standard 200 pounds per square inch (psi) WOG minimum. Valve ends shall be compatible with the piping system served.
- C. Composition disks shall be as recommended by the valve manufacturer for hot or cold water service.
- D. Gate valves for water main service shall be iron body, bronze mounted, tapered seat non-rising stem, O-ring packing. AWWA C500, 200 psi working pressure. Open counterclockwise. Mechanical joint valve ends shall conform to AWWA C111. Valves shall be of a design that requires no more than fifty (50) lbs. pull on the standard valve wrench to provide positive shutoff against rated working pressure.
- E. All flanges shall be plain faced, smooth finished and shall conform in dimensions and drilling to the American Cast Iron Flange Standard Class 125 (B16.1-48).
- F. Ring gaskets 1/16 inch thick shall be used with all flanged valves. Basis of design for gaskets shall be Cranite, Garlock. Paint one (1) side of gasket with graphite and oil, or accepted substitution, thread lubricant before installing.
- G. Domestic Hot and Cold Water Valves
 - 1. Ball Valves
 - a. 2-inch and Smaller - 200 psi WOG, full port, two-piece construction, bronze body with chrome plated solid brass ball and stem, threaded or sweat ends.

- b. Acceptable Manufacturers:
 - Apollo
 - Jamesbury
 - Milwaukee
 - Nibco
 - Powell
 - Watts
- 2. Gate Valves
 - a) 2-inch and Smaller - Bronze gate, union bonnet, rising stem, solid wedge disk, threaded or sweat ends
 - b) 2-1/2-inch and Larger - Iron body bronze mounted OS&Y, solid wedge disk, flanged ends.
 - c) Acceptable Manufactures:
 - Kennedy
 - Milwaukee
 - Mueller
 - Nibco
 - Powell
 - Stockham
- 3. Balancing Cocks (Circuit Setters)
 - a) Bronze body threaded or sweat connection, brass valve, "O" ring sealed, calibrated nameplate, indicator pointer, dual stage orifice, read out ports equipped with integral composition check valve, 125 psi rated, 20 degrees F to 220 degrees F range.
 - b) Acceptable Manufacturers:
 - Bell and Gossett
 - Illinois
 - Rockwell
 - Sarco
 - Taco
- 4. Check Valves (Swing Type)
 - a) 2-inch and Smaller - Bronze body, bronze disk for general service, threaded or sweat ends.
 - b) 2-1/2-inch and Larger - Cast iron body, bronze disk and seat ring; flanged ends.
 - c) Acceptable Manufacturers:
 - Kennedy
 - Milwaukee

Mueller
Nibco
Powell
Stockham

2.7 PIPE IDENTIFICATION LABELS

- A. Labels shall be acrylic faced, wrap-around labels. Labels shall indicate piping contents, direction of flow and shall bear the manufacturer's standard color for the service indicated.
 - 1. Approved Manufacturers:
 - Brimar
 - MSI
 - Seton

2.8 VALVE TAGS

- A. Tags shall be brass, 1" in diameter with large, stamped numerals and attached by a short link brass chain or brass "S" hook.

2.9 UTILITY MARKING TAPE

- A. Minimum 2 inches wide, metalized core plastic foil with the words "Caution - Pipeline Buried Below" printed in bold black letters.

PART 3 EXECUTION

3.1 GENERAL

- A. All materials, equipment and accessories specified in this section shall be installed in strict accordance with the manufacturers' recommendations.

3.2 EXCAVATION, COMPACTION, BACKFILL

- A. Excavation, compaction and backfill shall be as specified in Section 220100, Plumbing General.

3.3 PIPING INSTALLATION

- A. General
 - 1. All piping in finished areas shall be run concealed where possible. The Contractor shall furr in piping or provide soffit as required and in accordance with the Professional's

instructions. All piping shall be installed as required to suit space available in building structure, above suspended ceilings, and other locations found necessary for installation.

2. The Contractor shall not install any piping that will interfere with any lights, openings, doors, windows, ductwork, equipment, and existing or special conditions. Headroom in front of openings, doors, or windows shall not be less than the top of the opening. Provide all piping offsets necessary to avoid interferences with other work. Piping offsets shall include all devices and assemblies necessary to accommodate the change in direction of the piping.
3. All piping shall run straight with no more couplings and joints than necessary, shall be grouped wherever practical and shall be carefully installed to provide for proper alignment slope and expansion
4. Pipes carrying fluids shall not be installed in transformer vaults, electrical equipment rooms, elevator hoistways, elevator equipment rooms, or similar areas having a collection of electrical equipment. Pipes shall not be installed over, around, in front of, behind, or directly below, electrical controls, panels, switches, terminals, boxes, or similar electrical equipment.
5. All piping shall be installed with a minimum of 2 inches between finish covering of pipe and all other work or piping.
6. All piping shall have shut-off valves at all branch connections to mains.
7. Reduction in sizes of pipes shall be made with reducing fittings. Bushings will not be permitted.
8. The Contractor shall perform excavation of the subgrade where required for the installation of the work, including that for piping and piping enclosures. The backfill shall be stabilized by hand or pneumatic tamping as directed by the Professional and shall be returned to the original subgrade level. Piping shall not be run in cinder fill unless protected by a concrete envelope of 2 inches minimum thickness on all sides of pipe. All steel and copper piping and fittings installed underground shall be protected with two layers of tightly applied spirally wrapped tape. Basis of design shall be 3M number 50.
9. Bullhead connections in any piping service are prohibited.
10. All screwed joints shall be made with a non-corrosive, non-hardening compound or Teflon tape applied on the male thread only. All compounds must be approved for the pipe on which they are used. Pipe ends shall be reamed or filed out to size of bore and all chips and cuttings removed. Ends of pipe must be cut square so as to seat in the bottom of the recess in drainage fittings. In making joints in chromium plated brass pipe no more than one thread shall remain exposed when joint is completed. Caulking of screwed joints is not permitted. Pipe joint cement and paint will be permitted only on external threads.
11. All soldered joints shall be made with fittings specified. Copper tube and brass pipe, valves, unions, flanges, fittings, and connections shall be joined by means of lead-free solder. Ends of all pipe and inside surfaces of fittings shall be cleaned, burnished and tinned before solder is applied. All joints in tubing 2 inches and larger shall be tinned

and then soldered with a circular type flame torch. Pull joints, saddle type joints, and "T-Drill" type connections are prohibited.

B. Drainage Piping

1. All sewer piping shall be set true to line and even slope using grade boards and targets or grade lines in accordance with ASTM C12, "Recommended Practice for Laying Sewer Pipe". Horizontal sanitary and storm piping shall be installed to pitch towards drain points. Minimum pitch shall be 1/8 inch per foot for piping 4 inch and larger. Pitch for smaller piping shall be 1/4 inch per foot minimum. Minimum pipe size below grade shall be 2 inch. To join screwed pipe to cast iron pipe, provide ring on screwed pipe to form spigot end.
2. All changes in pipe size of soil, waste, and drain lines shall be made with reducing fittings or reducers. Changes in direction, where space permits, shall be made with long sweep bends, Y-fittings, and one-eighth (1/8) or one-sixteenth (1/16) bends, or combination "Y" and 1/8 bends.
3. Cleanouts shall be furnished installed on horizontal runs and at the base of stacks for all soil, waste, drain, and rain conductor lines. A cleanout shall be installed at every change of direction of greater than 45 degrees. Cleanouts shall be installed not more than 50 feet apart for piping 4 inch size and smaller. Cleanouts shall be installed no more than 80 feet apart for piping larger than 4 inch. Cleanouts on horizontal runs above ground, including crawl spaces, shall be cast brass plugs in wye fittings. Cleanouts at the base of each vertical stack shall be cast brass plugs in wye fittings. Cleanouts on buried or concealed lines shall be brought flush with grade or floor level. Cleanouts in walls shall be brought flush with finished face of the wall. Cleanouts on underground lines shall be made with wye and 45 degree fittings. Terminal cleanouts on underground lines shall have a concrete cradle bearing block set against undisturbed earth. 45 degree fittings shall be set against concrete cradle to prevent separation or misalignment of joints. Cleanout plugs shall be full size for pipe up to and including 4 inch diameter and not less than 4 inch diameter for larger size pipe.
4. Cleanouts shall not be located in air plenums. Cleanouts shall be extended to the floor or wall in order to locate the cleanout outside of the air plenum.

C. Pressure Piping

1. Branch piping shall be as indicated but shall be a minimum 3/4 inch in nominal size with the last ten feet to each 1/2 inch outlet fixture a minimum of 1/2 inch in nominal size.
2. Each water piping system within the building shall be properly arranged and graded to low points where the entire system can be emptied through a drain.
3. Drain Valves - Furnish and install a 1/2" rough brass hose bibb with female hose connection at all low points of the domestic water piping systems. The hose bibb shall be located to be accessible and easily operable, and so that a hose can be connected to the outlet.

4. Outside water piping shall be so graded and arranged that water can be drained from the underground piping through drains installed in the building served. The drains shall be the same size and type specified for interior piping.

D. Equipment Piping

1. Provide shutoff valves in supply and return to each item of equipment. Valves shall be suitably located to isolate each unit to facilitate maintenance or removal of all equipment and apparatus. Valves shall be flanged or have a union installed between valve and equipment.
2. Provide all piping from backflow preventers to spill over open sight drains, floor drains, or other trapped acceptable discharge points, and terminate with plain end (unthreaded) pipe.
3. Provide thermometer wells and pressure gauge wells for specified thermometers and gauges, and at the inlet and outlet connection of each piece of equipment specified in this contract.

3.4 ELECTROLYSIS CONTROL

- A. All copper pipe and tubing installed under this Contract shall be installed so that the pipe and tubing will not touch or come in contact with ferrous metals. Where copper tubing or piping for fittings is anchored, guided, supported, secured, or may come in contact with ferrous metal, an insulating nonconductor spacer, similar to rubber or fiber, shall be installed to assure prevention of electrolysis.
- B. When copper tubing or piping is connected to ferrous piping or equipment, connections shall be made with dielectric unions, couplings, or isolating flanges.

3.5 SLEEVES AND FLOOR PLATES

- A. Sleeves shall be provided for all pipes passing through walls and partitions. Sleeves shall be cut flush with wall, floor or ceiling surfaces except that sleeves through waterproofed roof or floor slabs shall extend one inch (1") above the finished surface. Sleeves shall be sufficient size to allow a sealable annular space between the sleeve and the pipe or between the sleeve and the pipe insulation. All exposed piping passing through floors, walls or ceiling shall be provided with a chrome escutcheon plate securely fastened around the pipe. The annular space around the pipe in non-water-proof sleeves shall be filled with penetration sealant and smoothed out flush with all surfaces.
- B. All pipe, tube, conduit, or similar through-penetrations of all fire rated walls, floor-ceiling, or roof-ceiling assemblies shall be provided with a fire stopping system to achieve a tight seal that will maintain the fire resistant rating of the assembly containing the through-penetration. Fire stopping system may be sealant or mechanical type.

3.6 PROTECTION AGAINST PHYSICAL DAMAGE

- A. In concealed locations, where piping, other than cast-iron or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1/4-inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16-inch thick steel, shall cover the area of the pipe where the member is notched or bored and shall extend a minimum of 2-inches above sole plates and below top plates.
- B. Fuel gas piping shall be protected in accordance with NFPA 54.

3.7 SUPPORTS, HANGERS, INSERTS AND FASTENERS

- A. The Contractor shall furnish and install all supports, hangers, inserts and fasteners for the items incidental to the work in the construction of the project. Supports and hangers shall be provided to suit specific conditions for the type of construction. The method adopted shall be subject to the approval of the Professional.
- B. Supports shall secure pipes in place, prevent swaying and vibration, maintain required grading, provide free expansion, and shall have a neat appearance. Supports shall be selected for strength and service and installed in a manner which will not stress building construction. Supports shall be selected for safety factor of five (5) to one (1) for gross weight of piping system including fluid and installation.
- C. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Only use inserts for suspending hangers from concrete slabs. Use beam clamps for suspending hangers from building steel. Do not hang one pipe from another. Do not use perforated band iron, wire or chain as hangers. Do not use vertical expansion shields. Do not hang from joist bridging.
- D. Fastenings required in masonry walls shall be galvanized U-bolts set in the construction during erection.
- E. Where several pipes can be installed in parallel at the same elevation, provide trapeze hangers. Trapeze hangers shall be suspended by means of rods or angles. Brace trapeze hangers to prevent motion due to expansion and contraction of pipe. Support individual pipes by hangers or rollers.
- F. Where hanger rods are longer than 18 inches, provide lateral bracing at every fourth hanger. Do not support piping by wire, rope, wood or other makeshift device. Provide additional steel supports where building construction does not permit the hanger spacing as specified in the schedules. Location and details shall be submitted to the Professional for review.
- G. Where loading exceeds the safe allowable limit for any single insert, then multiple inserts shall be installed spaced no less than 12 inches on centers. The multiple inserts shall be connected with suitable size steel angles and locking bolts.
- H. Where inserts in new construction have been omitted or are required in existing construction, the fastening shall be accomplished by means of approved lead sheathed expansion bolts. Wood plugs shall not be used. Expansion shields in precast concrete slabs shall not be loaded

more than one-half (1/2) their maximum design capacity and never more than 200 pounds per bolt. Where bolts used with lead expansion bolts are spaced closer than one foot centers, the multiple bolts shall be connected with suitable size steel angles and locking bolts or with single bolts extending through the slab above with a bearing plate. Where finished floors occur, the welded plate and rod shall be recessed in the slab, finished in an approved manner.

- I. Where fastenings are required in steel stud, wire lath or other non-masonry construction, a "J" hook and holding lock washer and nut shall be used which shall fasten to the opposite stud edge to which the item will abut. If the location of the fastening is not a steel stud, a structural steel shape shall be fastened to the wall with bolt and holding nut, with the fastening extension through the wall. The use of toggle bolts will not be permitted.
- J. Steel frame Construction
 - 1. Where roofing construction is supported by structural steel members or bar joist, support piping systems, devices, and equipment from structural steel members or secondary fabricated supports. No hanging from corrugated metal deck shall be allowed.
- K. Reinforced Concrete Construction
 - 1. Inserts in poured concrete slabs shall be iron or fabricated galvanized iron or steel of the type to receive a machine bolt head or nut after installation. Inserts shall permit adjustment of this bolt in one (1) horizontal direction. Inserts shall be accurately located before the concrete is poured.
 - 2. Piping, tanks and equipment shall be adequately supported either by suspension from the construction above or by means of struts or brackets to the construction below or to the side.
 - 3. Before drilling any concrete for attachments, installer shall carefully check concrete drawings and shop drawings and shall locate drilled holes to avoid reinforcing by at least 1 inch.

HANGER AND ROD SCHEDULE

Nominal Pipe Diameter (Inches)	Steel Pipe		Copper Tubing	
	Spacing (Feet)	Rod Size (Inches)	Spacing (Feet)	Rod Size (Inches)
1/2	5	3/8	5	3/8
3/4	6	3/8	6	3/8
1	7	3/8	6	3/8
1-1/4	8	3/8	6	3/8
1-1/2	10	3/8	6	3/8
2	10	3/8	10	3/8
2-1/2 & 3	12	1/2	10	1/2
4 & 5	12	5/8	10	5/8
6	12	3/4	10	7/8
8,10,12	12	7/8	10	7/8

HANGER AND ROD SCHEDULE NOTES:

Where unusual concentrated loads of valves and fittings occur, closer spacing shall be required. Submit specific cases for review and comment.

Where piping changes direction, supports shall be placed in each direction adjacent to joints and no more than 12 inches from the joint.

Hanger spacing for copper piping shall conform to the requirements defined in the North Carolina Building Code – Mechanical- 2002.

M. Cast Iron Pipe Supports

1. In accordance with manufacturer's instructions.
2. Vertical piping supported at each stack be and at each floor. Freestanding vertical pipe should be adequately staked or braced during construction to maintain alignment.
3. Horizontal piping supported within 24 in. each side of the coupling joint at 10 ft. intervals for 10 ft. pipe lengths and at 5 ft. intervals for 5 ft. pipe lengths. Supports or hangers placed to maintain alignment and grade with provision made to prevent shear. Greater than 3 in. diameter pipe braced at changes of direction to prevent horizontal movement.

3.8 VALVES

- A. Valves shall be installed at each riser, branch to equipment, at each group of fixtures, at each fixture not equipped with stop valves, and where shown on the drawings. Valves shall be installed with stems at or above the horizontal plane.
- B. Where supplies to individual fixtures occur in base cabinets, or in other places where copper tubing supplies are used stops shall be solder end.

3.9 PAINTING AND IDENTIFICATION

A. Painting

1. All painting shall be done in a careful, neat and workmanlike manner, with particular care being exercised to protect building equipment and finishes. All surfaces shall be thoroughly cleaned or rust, scale, dirt, grease, dust, and like items, and sanded so as to provide a bond for new paint. All painted surfaces under this Contract shall be finished in an acceptable manner.
2. Insulation, galvanized piping, and copper piping in crawl spaces, in sump pits, inaccessible pipe spaces, and above ceilings shall not be painted.
3. All unpainted, uncoated, or non-galvanized steel piping, equipment, supports, hangers and other iron and steel work in crawl spaces, and sump pump pit, installed under this Contract, shall be painted with two (2) coats of Rust-Oleum rust preventative paint, or approved equal. First coat shall be Rust-Oleum No. X-60 red primer, or accepted substitute. The second coat shall be Rust-Oleum No. 634 black gloss, or accepted substitute.

B. Pipe Identification

1. All piping (domestic cold water, de-ionized water, fuel gas, chemical waste, laboratory compressed air and laboratory vacuum piping) shall be provided with identification markers. Markers shall be provided as follows:
 - a. On straight runs of piping at intervals not exceeding 20-feet
 - b. Within 2-feet of all elbows
 - c. Within 2-feet of all piping as it passes through partitions (markers provided on both sides of partitions)

C. Valve Tags

1. The Contractor shall tag each valve for the cold water, hot water, hot water circulating, gas lines, laboratory compressed air, laboratory vacuum and de-ionized water systems furnished under this Contract. The Contractor shall prepare three (3) lists on heavy white paper giving the valve number, its location, and the equipment controlled. One (1) list shall be enclosed in a metal frame under glass and mounted in the building where directed by the Owner. The other two (2) copies shall be delivered to the Architect.
2. In buildings where existing piping systems are modified, the new valve tag numbers and list shall be coordinated with existing valve tag numbers and lists and those supplied under other contracts, if applicable.

D. Utility Marking Tape

1. Install detectable utility marking tape above all outside pipelines, 12 inches to 18 inches below grade.

END OF SECTION 221101

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SECTION 221102 – GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. The cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character and quality of product desired; and that equivalent products will be acceptable.

1.2 SUMMARY

A. Section Includes:

- 1. Gate valves.
- 2. Ball valves.
- 3. Butterfly valves.
- 4. Check valves.
- 5. Globe valves
- 6. Chainwheels

B. Related Sections:

- 1. Section 221101 - Plumbing Piping
- 2. Section 221103 - Plumbing Insulation
- 3. Section 221104 - Hangers and Supports for Plumbing Piping and Equipment
- 4. Section 222401 - Domestic Water System and Specialties
- 5. Section 222403 - General Service Compressed Air Systems
- 6. Section 222423 - Natural Gas System and Specialties
- 7. Section 222501 - Sanitary Waste and Vent System and Specialties
- 8. Section 222502 - Storm Drainage System and Specialties

1.3 REFERENCES

- A. Refer to Section 220501 for complete listing of references.

1.4 SUBMITTALS

- A. Section 220502 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Requirements for submittals.
- B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of valves.
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with all NCBC Plumbing Code requirements.
- B. Maintain one copy of the NCBC Plumbing Code document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience [approved by manufacturer].

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting 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.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install valves underground when bedding is wet or frozen.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five year manufacturer warranty for valves excluding packing.

1.12 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish two (2) packing kits for each size valve.

PART 2 - PRODUCTS

2.1 GATE VALVES

- A. Manufacturers:
 - 1. Conbraco Industries, Inc.; Apollo Valve
 - 2. Crane Valve, North America
 - 3. Hammond Valve
 - 4. Milwaukee Valve Company
 - 5. NIBCO, Inc.
 - 6. Stockham Valves & Fittings
- B. 2-inches and Smaller: MSS SP 80, Class 150, bronze body, bronze trim, union bonnet, rising stem, hand-wheel, inside screw, solid wedge disc, alloy seat rings, solder or threaded ends.
- C. 2½-inches and Larger: MSS SP 70, Class 125, cast iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6-inches and larger mounted over 8-feet above floor.

2.2 BALL VALVES

- A. Manufacturers:
 - 1. Conbraco Industries, Inc.; Apollo Valve
 - 2. Crane Valve, North America
 - 3. Hammond Valve
 - 4. Milwaukee Valve Company
 - 5. NIBCO, Inc.
 - 6. Stockham Valves & Fittings
- B. 2-inches and Smaller: MSS SP 110, 400 psi WOG, two-piece bronze body, chrome plated brass ball, full port, teflon seats, blow-out proof stem, solder or threaded ends with union, lever handle.

2.3 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Conbraco Industries, Inc.; Apollo Valves
 - 2. Crane Valve, North America
 - 3. Hammond Valve
 - 4. Milwaukee Valve Company
 - 5. NIBCO, Inc.
 - 6. Stockham Valves & Fittings
- B. 2½-inches and Larger: MSS SP 67, Class 150.
 - 1. Body: Cast or ductile iron, wafer, lug or grooved ends, stainless steel stem, extended neck.
 - 2. Disc: Stainless steel.
 - 3. Seat: Resilient replaceable EPDM, Buna N or neoprene Viton.
 - 4. Handle and Operator: Infinite position lever handle with memory stop. Furnish gear operators for valves 8-inches and larger, and chain-wheel operators for valves mounted over 8-feet above floor.

2.4 CHECK VALVES

- A. Horizontal Swing Check Valves:

1. Manufacturers:
 - a. Crane Valve, North America
 - b. Hammond Valve
 - c. Milwaukee Valve Company
 - d. NIBCO, Inc.
 - e. Stockham Valves & Fittings
2. 2-inches and Smaller: MSS SP 80, Class 125 (200 CWP), bronze body and cap, bronze seat, Buna-N disc, threaded ends.
3. 2½-inches and Larger: MSS SP 71, Class 125 (200 CWP), cast iron body, bolted cap, bronze or cast iron disc, renewable disc seal and seat, flanged ends.

B. Spring Loaded Check Valves:

1. Manufacturers:
 - a. Crane Valve, North America
 - b. Hammond Valve Model
 - c. Milwaukee Valve Company
 - d. NIBCO, Inc.
 - e. Stockham Valves & Fittings
2. 2-inches and Smaller: MSS SP 80, Class 250, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, threaded ends.
3. 2½-inches and Larger: MSS SP 71, Class 125, wafer style, cast iron body, bronze seat, center-guided bronze disc, stainless steel spring and screws, flanged ends.

2.5 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.

- c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Zy-Tech Global Industries, Inc.
2. Description:
- a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

2.6 CHAINWHEELS

- A. Manufacturers:
- 1. Babbitt Steam Specialty Co.
 - 2. Roto-Hammer Industries.
 - 3. Trumbull Industries
- B. Description: Valve actuation assembly with sprocket rim, brackets and chain.
- 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Retain first subparagraph below for ball, butterfly, and plug valves.
 - 3. Attachment: For connection to ball and butterfly valve stems.

4. Sprocket Rim with Chain Guides: Ductile or cast iron aluminum or bronze, of type and size required for valve.
5. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify piping system is ready for valve installation.
 1. 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.
 2. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
 3. Examine threads on valve and mating pipe for form and cleanliness.
 4. 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.
 5. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install valves in position to allow full stem movement.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install $\frac{3}{4}$ -inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- E. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- F. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Division 08.
- G. Install chain wheels on operators for valves NPS 4 and larger and more than 96-inches above floor. Extend chains to 60-inches above finished floor.

- H. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.
- I. Refer to Section 221104 for pipe hangers.
- J. Refer to Section 221103 for insulation requirements for valves.
- K. Refer to Section 221101 for piping materials applying to various system types.
- L. For installation of valves in domestic water systems refer to Section 222401.
- M. For installation of valves in general service compressed air systems refer to Section 222403.
- N. For installation of valves in natural gas systems refer to Section 222423.
- O. For installation of valves in sanitary systems refer to Section 222501.
- P. For installation of valves in storm systems refer to Section 222502.

3.3 VALVE APPLICATIONS

- A. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section or as required.
- B. Install gate valves only as required on water utility entrance per local utility requirements.
- C. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe valves for throttling, bypass, or manual flow control services.
- E. Install spring loaded check valves on discharge of water pumps.
- F. Install lug end butterfly valves adjacent to equipment when functioning to isolate equipment.
- G. Install ball or butterfly valves in domestic water systems for shut-off service.
- H. Install globe valves in domestic water systems for throttling service.

3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing.
- B. Replace valves if persistent leaking occurs.

END OF SECTION 221102

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SECTION 221103 – PLUMBING INSULATION

PART 1 GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.

1.2 SUMMARY

- A. Section Includes:
1. Piping system insulation.
 2. Pipe insulation jackets.
 3. Insulation accessories including vapor retarders and accessories.
- B. Related Sections:
1. Division 09 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.
 2. Section 220553 - Identification for Plumbing Piping and Equipment: Product requirements for plumbing piping and equipment identification.
 3. Section 221104 - Hangers and Supports for Plumbing Piping and Equipment: Product and Execution requirements for inserts at hanger locations.

1.3 REFERENCES

- A. Refer to Section 220501 for complete listing of references.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures and 22 05 02 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail insulation application at pipe expansion joints for each type of insulation.
 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
 5. Detail application of field-applied jackets.

6. Detail application at linkages of control devices.
7. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
 1. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - a) Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - b) Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Perform Work in accordance with State, Federal and local standards.
- C. 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.
- D. Maintain one (1) copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three (3) years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature during and after installation for minimum period of 24 hours.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Certain Teed Corporation
- B. Johns Manville Co.
- C. Knauf Fiberglass GmbH
- D. USG Interiors, Inc. – Thermafiber Division
- E. Owens-Corning Fiberglass Corporation
- F. or other equivalent product.

2.2 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; Foamglas Super K.
 - c) or other equivalent product.
 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 fabricated 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.
 - d) or other equivalent product.
- H. 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) Manson Insulation Inc.; Alley-K.
 - e) Owens Corning; Fiberglas Pipe Insulation.
 - f) or other equivalent product. 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 or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a) Armacell LLC; Tubolit.
 - b) Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

- c) RBX Corporation; Therma-cell.
- d) or other equivalent product.

2.3 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.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Childers Products, Division of ITW; CP-97.
 - b) Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
 - c) Marathon Industries, Inc.; 290.
 - d) Mon-Eco Industries, Inc.; 22-30.
 - e) Vimasco Corporation; 760.
 - f) or other equivalent product.
- 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 available products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Childers Products, Division of ITW; CP-96.
 - b) Foster Products Corporation, H. B. Fuller Company; 81-33.
 - c) or other equivalent product.
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Aeroflex USA Inc.; Aero seal.
 - b) Armacell LCC; 520 Adhesive.
 - c) Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d) RBX Corporation; Rubatex Contact Adhesive.
 - e) or other equivalent product.
- 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 available products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Childers Products, Division of ITW; CP-82.
 - b) Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c) ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d) Marathon Industries, Inc.; 225.
 - e) Mon-Eco Industries, Inc.; 22-25.
 - f) or other equivalent product.

- 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 available products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Childers Products, Division of ITW; CP-82.
 - b) Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c) ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d) Marathon Industries, Inc.; 225.
 - e) Mon-Eco Industries, Inc.; 22-25.
 - f) or other equivalent product.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, 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.
 - f) or other equivalent product.

2.4 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.
 - g) or other equivalent product.
 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.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:

- a) Childers Products, Division of ITW; CP-10.
 - b) Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c) ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d) Marathon Industries, Inc.; 550.
 - e) Mon-Eco Industries, Inc.; 55-50.
 - f) Vimasco Corporation; WC-1/WC-5.
 - g) or other equivalent product.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 4. Solids Content: 63 percent by volume and 73 percent by weight.
 5. Color: White.

2.5 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) Marathon Industries, Inc.; 130.
 - d) Mon-Eco Industries, Inc.; 11-30.
 - e) Vimasco Corporation; 136.
 - f) or other equivalent product.
 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.

2.6 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass, Phenolic, 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) Marathon Industries, Inc.; 405.
 - d) Mon-Eco Industries, Inc.; 44-05.
 - e) Pittsburgh Corning Corporation; Pittseal 444.
 - f) Vimasco Corporation; 750.
 - g) or other equivalent product.
 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.
 - f) or other equivalent product.
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. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 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.
5. 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.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. 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.
 - b) PABCO Metals Corporation; Surefit.
 - c) RPR Products, Inc.; Insul-Mate.
 - d) or other equivalent product.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
- a) Sheet and roll stock ready for shop or field sizing Factory cut and rolled to size.
 - b) Finish and thickness are indicated in field-applied jacket schedules.
 - c) Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - d) Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e) 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.
- C. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.9 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.
 - e) or other equivalent product.
 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. 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.
 - e) or other equivalent product.
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.
- C. 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.
 - e) or other equivalent product.
 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.
- D. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Width: 3-inches.
 2. Film Thickness: 6-mils.
 3. Adhesive Thickness: 1.5-mils.
 4. Elongation at Break: 145-percent.
 5. Tensile Strength: 55-lbf/inch in width.

2.10 SECUREMENTS

- A. Bands:
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; Bands.
 - b) PABCO Metals Corporation; Bands.
 - c) RPR Products, Inc.; Bands.
 - d) or other equivalent product.
 2. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304 or Type 316; 0.015 inch thick, 1/2 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, 1/2 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.
 5. 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - 4) or other equivalent product.
 - b) Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c) Spindle: Copper- or zinc-coated, low carbon 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.
6. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened 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) Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - b) Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - c) Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
7. Self-Sticking-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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - 4) or other equivalent product.
 - b) Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c) Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d) Adhesive-backed base with a peel-off protective cover.
8. 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - 5) or other equivalent product.
 - b) Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

9. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.
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) C & F Wire.
 - b) Childers Products.
 - c) PABCO Metals Corporation.
 - d) RPR Products, Inc.
 - e) or other equivalent product.

2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 x 1-inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 x 1-inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 x 1-inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify piping and equipment has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 INSTALLATION

- A. Exposed Piping: Locate insulation and cover seams in least visible locations.
- B. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- C. Man made mineral fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- E. Man made mineral fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- F. Inserts and Shields:
 - 1. Application: Piping 1½-inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert location: Between support shield and piping and under finish jacket.
 - 4. Insert configuration: Minimum 6-inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - 5. Insert material: Compression resistant insulating material suitable for planned temperature range and service.
- G. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetrations of assemblies with fire resistance rating greater than one hour.
- H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 8- feet above finished floor): Finish with aluminum jacket or stainless steel jacket.
- I. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal equipment.

- J. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1-mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- K. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water.
- L. Factory Insulated Equipment: Do not insulate.
- M. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- N. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- O. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- P. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- Q. Mineral fiber insulated equipment containing fluids below ambient temperature: Provide vapor retarder jackets, factory-applied or field-applied. Finish with glass-cloth and vapor barrier adhesive.
- R. Mineral fiber insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor retarder, factory-applied or field-applied. Finish with glass cloth and adhesive.
- S. Finish insulation at supports, protrusions, and interruptions.
- T. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- U. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- V. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.4 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, 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.

3.5 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 field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.6 SCHEDULES

- 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. Underground copper piping.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
- C. Plumbing Systems:
 - 1. Domestic Hot (Tempered) Water Supply:
 - a) 1-1/4 NPS and smaller:
 - 1) Man Made Mineral Fiber Insulation: 1-inch
 - 2) Cellular Glass Insulation: 1½-inch
 - 3) Cellular Polyisocyanurate Insulation: 1-inch
 - 4) Cellular Phenolic Foam Insulation: 1-inch
 - 5) Elastomeric Cellular Foam Insulation: ¾-inch
 - b) 1-1/2 NPS and larger:
 - 1) Man Made Mineral Fiber Insulation: 1-inch

- 2) Cellular Glass Insulation: 1½-inch
- 3) Cellular Polyisocyanurate Insulation: 1-inch
- 4) Cellular Phenolic Foam Insulation: 1-inch
- 5) Elastomeric Cellular Foam Insulation: 1-inch
2. Domestic Cold Water:
 - a) 1 NPS and smaller:
 - 1) Man Made Mineral Fiber Insulation: 1-inch
 - 2) Cellular Glass Insulation: 1½-inch
 - 3) Cellular Polyisocyanurate Insulation: 1-inch
 - 4) Cellular Phenolic Foam Insulation: 1-inch
 - 5) Elastomeric Cellular Foam Insulation: ¾-inch
 - b) 1-1/4 NPS and larger:
 - 1) Man Made Mineral Fiber Insulation: 1-inch
 - 2) Cellular Glass Insulation: 1½-inch
 - 3) Cellular Polyisocyanurate Insulation: 1-inch
 - 4) Cellular Phenolic Foam Insulation: 1-inch
 - 5) Elastomeric Cellular Foam Insulation: 1-inch
3. Sanitary Drainage from floor drains receiving condensate from HVAC systems: ¾-inch Elastomeric Cellular Foam from floor drain body and all horizontal pipe runs.
4. Sanitary Drainage from electric water coolers: ¾-inch Elastomeric Cellular Foam.

D. Plumbing Systems:

1. Domestic Hot Water Storage Tanks (not Factory Insulated):
 - a) Mineral Fiber Blanket Insulation: 2-inches thick.
 - b) Mineral Fiber Board Insulation: 1½- inches thick.
 - c) Hydrous Calcium Silicate Insulation: 1½-inches thick.
 - d) Cellular Phenolic Foam Insulation: 1½-inches thick.
 - e) Glass Fiber, Rigid Insulation: 2-inches thick.

END OF SECTION 221103

SECTION 221104 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. The cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character and quality of product desired; and those equivalent products will be acceptable.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports
 - 2. Hanger rods
 - 3. Inserts
 - 4. Flashing
 - 5. Sleeves
 - 6. Escutcheons
 - 7. Mechanical sleeve seals
 - 8. Formed steel channel
 - 9. Grout
 - 10. Firestopping relating to plumbing work
 - 11. Firestopping accessories
 - 12. Equipment bases and supports
- B. Related Sections:
 - 1. Division 03 - Concrete Forming and Accessories
 - 2. Division 03 - Cast-In-Place Concrete

3. Division 07 – Fire-stopping
4. Division 07 - Joint Protection
5. Division 07 - Installation requirements for roof flashing installation.
6. Division 09 - Painting and Coating
7. Section 220501 - Common Work Results for Plumbing
8. Section 222401 - Domestic Water System and Specialties
9. Section 222433 - Natural Gas System and Specialties
10. Section 222501 - Sanitary Waste and Vent System and Specialties
11. Section 222502 - Storm Water Collection System and Specialties

1.3 REFERENCES

- A. Refer to Section 220501 for complete listing of references.

1.4 DEFINITIONS

- A. Fire-stopping (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.

1.5 SYSTEM DESCRIPTION

- A. Fire-stopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479, to achieve fire ratings of adjacent construction in accordance with FM or UL requirements. Fire-stopping material shall be compatible with PEX piping.
- B. Surface Burning: ASTM E84 UL 723 with maximum flame spread / smoke developed rating of 25/50.
- C. Fire-stop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

- A. Fire-stopping: Conform to applicable code (FM or UL) for fire resistance ratings and surface burning characteristics.
- B. Fire-stopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.7 SUBMITTALS

- A. Section 220502 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals:

Submittal procedures.

B. Shop Drawings:

1. Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers, metal framing systems, pipe stands and/or equipment supports.
2. Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations.

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Fire-stopping: Submit data on product characteristics, performance and limitation criteria.

D. Fire-stopping 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. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

F. Welding certificates.

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.

1.8 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.

B. Through Penetration Fire-stopping 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 minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- G. Perform Work in accordance with State of North Carolina and local standards.
- H. Maintain one (1) copy of each document on site.
- 1.9 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- 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 damage, by storing in original packaging.
- 1.11 ENVIRONMENTAL REQUIREMENTS
- A. Division 01 - Product Requirements: Environmental conditions affecting products
- B. Do not apply fire-stopping materials when temperature of substrate material and ambient air is below 60-degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3-days after installation

of fire-stopping materials.

- D. Provide ventilation in areas to receive solvent cured materials.

1.12 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.13 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Provide all miscellaneous steel required for support of pipes and equipment other than steel shown on Structural Engineer's drawings.
- B. Pipe hanger design, materials, and manufacturer shall conform to the requirements defined in MSS SP58-88.
- C. The selection and spacing of pipe hangers shall comply with the data included in MSS SP69-91.
- D. All hanger materials including clevis hangers, rods, inserts, clamps, stanchions, brackets, shall have a factory applied finish of electro-plated zinc, unless noted otherwise.
- E. Hangers, clamps and supports for use on un-insulated copper piping shall be provided with inserts to isolate the copper piping from the hanger. Inserts shall be made of felt or plastic and shall be as manufactured by the hanger manufacturer.
- F. Insulated piping shall be provided with insulation shields. Hanger shall be sized to include piping diameter and insulation thickness.
- G. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Carpenter & Paterson Inc.
 - 3. ERICO/Michigan Hanger Co.
 - 4. Globe Pipe Hanger Products Inc.
 - 5. Grinnell Corp.
 - 6. MIRO Industries, Inc.
 - 7. PHD Manufacturing, Inc.

- 8. Tolco Inc.
- 9. Unistrut Corp.; Tyco International, Ltd.

H. Hanger Materials:

1. Horizontal Sanitary, Waste and Vent Piping and Storm water Piping:

a. 3-inch and smaller:

- 1) B-Line B3100
- 2) Anvil 260
- 3) PHD 450

b. 4-inch and larger:

- 1) B-Line B3102
- 2) Anvil 590
- 3) PHD 420

2. Horizontal Domestic Water Piping:

a. 2-inch and smaller:

- 1) B-Line B3100; B3106V
- 2) Anvil 260
- 3) PHD 450; 450T

b. 2½-inch and larger:

- 1) B-Line B3100
- 2) Anvil 260
- 3) PHD 450

c. AWWA piping:

- 1) B-Line B3102
- 2) Anvil 590
- 3) PHD 420

- 3. Insulation Shields
 - a. All Piping:
 - 1) B-Line B3155
 - 2) Anvil 168
 - 3) PHD 160

- 4. Vertical Piping (Riser Clamps):
 - a. Copper Pipe (copper plated with plastic coated formed portion.):
 - 1) B-Line B3373CT
 - 2) Anvil CT-121C
 - 3) PHD 554
 - b. Steel Pipe:
 - 1) B-Line B3373
 - 2) Anvil 261
 - 3) PHD 550

- 5. Connectors:
 - a. Beam Clamps:
 - 1) B-Line B3033, B3050, B3291-B3297
 - 2) Anvil 88, 133, 134 or 292S
 - 3) PHD 360, 620
 - b. Concrete inserts:
 - 1) B-Line B2500, B3014
 - 2) Anvil 282, 285
 - 3) PHD 950
 - c. Welded beam attachments:
 - 1) B-Line B3083

- 2) Anvil 66
- 3) PHD 900
- d. Piping adjacent to walls or steel columns, brackets:
 - 1) B-Line 173
 - 2) Anvil No. 194, 195, or 199 depending on weight to be supported.
 - 3) PHD
- e. Base supports:
 - 1) B-Line B3089
 - 2) Anvil Figure No. 259, or 264.
 - 3) PHD
- 6. Hanger Rods:
 - a. Hanger rod:
 - 1) B-line B3205
 - 2) Anvil Figure No. 140.
 - 3) PHD 15
 - b. Continuous threaded rod:
 - 1) B-line B3174
 - 2) Anvil Figure No. 146.
 - 3) PHD 500
 - c. Eye Rods:
 - 1) B-line B3210
 - 2) Anvil Figure No. 248
 - 3) PHD 50
- 7. Trapeze Hangers:
 - a. Direct Mounting Hangers:

- | | | |
|----|--------|---------------|
| 1) | B-line | BFP22, BFP42 |
| 2) | Anvil | Figure No. 46 |
| 3) | PHD | B900 |

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. 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.

2.4 FLASHING

- A. Metal flashing: 26 gage thick galvanized steel.
- B. Metal counter flashing: 22 gage thick galvanized steel.
- C. Lead Flashing:
1. Waterproofing: 5 lb/sq ft sheet lead.
 2. Soundproofing: 1 lb/sq ft sheet lead.
- D. Flexible flashing: 47 mil thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gauge at fire resistant elements.

2.5 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. Sleeve in paragraph below is available with many end variations.
- D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop, unless otherwise indicated.
- E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Under Deck Clamp: Clamping ring with set screws.

2.6 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 and rough brass.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 MECHANICAL SLEEVE SEALS

- A. Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 12-gage thick steel. With holes 1½-inches on center.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000 psi, 28-day compressive strength.
- B. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive fire-stopping.

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 materials to arrest liquid material leakage.
- D. Obtain permission from the Professional before using powder-actuated anchors.
- E. Do not drill or cut structural members.

3.3 INSTALLATION – INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4-inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1, ASME B31.5, ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69, and/or MSS SP 89.
- B. Support horizontal piping as scheduled.

- C. Install hangers with minimum ½-inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1½-inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hangers and/or support bare copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat exposed steel hangers and supports. Refer to Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 221103.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3½-inches thick and extending 6-inches beyond supported equipment. Refer to Division 03.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members, formed steel channel or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 220549.

3.6 INSTALLATION – FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3-inches minimum above finished roof surface with lead or material compatible with roofing worked 1-inch minimum into hub, 8-inches minimum clear on sides with 24 x 24-inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.

- C. Flash floor drains in floors with topping over finished areas with lead, 10-inches clear on sides with minimum 36 x 36-inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, shower, and mop sink drains watertight to adjacent materials.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 INSTALLATION – SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1½-inches above finished floor level. Caulk sleeves. Extend sleeves through floors 3-inches above finished floor level in Kitchen or wet-areas.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with fire-stopping insulation and caulk watertight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel or stainless-steel escutcheons at finished surfaces.

3.8 INSTALLATION – FIRE-STOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, and other items, requiring fire-stopping.
- B. Apply primer where recommended by manufacturer for type of fire-stopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply fire-stopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- E. 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 1inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1inch 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.

F. Non-Rated Surfaces:

1. Seal opening through non-fire rated floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1-inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of fire-stopping material recommended by manufacturer.
2. Install escutcheons where piping, 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 sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations at telecommunication rooms, data rooms, and electrical rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.9 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements or - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed fire-stopping for compliance with specifications and submitted schedule.

3.10 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of fire-stopping materials.

3.11 PROTECTION OF FINISHED WORK

- A. Division 01 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULES

PIPE HANGER SPACING

PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
Cross-linked Polyethylene (PEX)	32 Inches*	3/8
Cast Iron (All Sizes)	5	5/8
Cast Iron (All Sizes) with 10 foot length of pipe	10	5/8
Copper Tube, 1-1/4 inches and smaller	6	1/2
Copper Tube, 1-1/2 inches and larger	10	1/2
Steel, 3 inches and smaller	12	1/2
Steel, 4 inches and larger	12	5/8

*If continuous pipe support is used, hanger spacing can be extended to the length of the support.

END OF SECTION 221104

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SECTION 221323 - SANITARY WASTE AND VENT SYSTEM AND SPECIALITIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sanitary sewer piping buried within 5 feet of building.
2. Sanitary sewer piping above grade.
3. Storm piping buried within 5 feet of building.
4. Storm piping above grade.
5. Unions and flanges.
6. Floor drains.
7. Indirect drains.
8. Roof drains.
9. Cleanouts.

B. Related Sections:

1. Section 033000 - Cast-In-Place Concrete: Execution requirements for placement of concrete specified by this section.
2. Section 078400 – Fire-stopping: Product requirements for fire-stopping for placement by this section.
3. Section 083113 - Access Doors and Frames: Product requirements for access doors for placement by this section.
4. Section 099000 - Painting and Coating: Product and execution requirements for painting specified by this section.
5. Section 220516 - Expansion Fittings and Loops for Plumbing Piping: Execution requirements for pipe expansion devices for placement by this section.
6. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and fire-stopping for placement by this section.
7. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment: Product requirements for vibration isolators for placement by this section.
8. Section 220553 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
9. Section 220700 - Plumbing Insulation: Product and execution requirements for pipe insulation.
10. Section 221323 – Sanitary Waste Interceptors: Product requirements for solids, lint, oil and grease interceptors; and, laboratory waste neutralization.
11. Section 260503 - Equipment Wiring Connections: Execution requirements for electric connections to equipment specified by this section.
12. Section 310513 - Soils for Earthwork: Soils for backfill in trenches.
13. Section 310516 - Aggregates for Earthwork: Aggregate for backfill in trenches.
14. Section 312316 - Excavation: Product and execution requirements for excavation and backfill required by this section.
15. Section 312317 - Trenching: Execution requirements for trenching required by this section.
16. Section 312323 - Fill: Requirements for backfill to be placed by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
1. ASME A112.14.1 - Backwater Valves.
 2. ASME A112.21.1 - Floor Drains.
 3. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 4. ASME B16.3 - Malleable Iron Threaded Fittings.
 5. ASME B16.4 - Gray Iron Threaded Fittings.
 6. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
 7. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
 8. ASME B31.9 - Building Services Piping.
- B. ASTM International:
1. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.
 2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 3. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 4. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 5. ASTM A395 - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 6. ASTM A536 - Standard Specification for Ductile Iron Castings.
 7. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
 8. ASTM B32 - Standard Specification for Solder Metal.
 9. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
 10. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
 11. ASTM B75 - Standard Specification for Seamless Copper Tube.
 12. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 13. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 14. ASTM B302 - Standard Specification for Threadless Copper Pipe.
 15. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
 16. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 17. ASTM C1053 - Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.
 18. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 19. ASTM D2996 - Standard Specification for Filament-Wound Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
 20. ASTM D2997 - Standard Specification for Centrifugally Cast Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
 21. ASTM D3262 - Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
 22. ASTM D3840 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Non-pressure Applications.
 23. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

24. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- C. Cast Iron Soil Pipe Institute:
 1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.3 SUBMITTALS

- A. Section 220501 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings for drains.
- C. Product Data:
 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 2. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 3. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
 4. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of equipment and clean-outs.
- C. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include, spare parts lists, exploded assembly views for pumps and equipment.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of North Carolina standards.
- B. After installation and testing of underground sanitary, grease waste, solid waste, and storm water piping the contractor shall be completely rod and flush all systems. Two diagnostic videos of all systems shall be done by an independent third party to assure all lines are undamaged and there is proper installation, adequate slope, etc. Video inspections shall be done following completion of slab work and following completion of sanitary installation. The third party shall issue a report along with video tape data of all lines. Any deficiencies shall be identified, and their locations shall be clearly indicated on a site drawing attached to the report. The report and video recording (DVD) information shall be reviewed by the Engineer.

1.6 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.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 013000 - Administrative Requirements: Pre-installation meeting.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 SANITARY AND STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Soil Pipe: ASTM A74, service weight, bell and spigot end.
 - 1. Fittings: Cast iron, ASTM A74.

2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. Ductile Iron Pipe: ASTM A746, service weight, bell and spigot end.
1. Fittings: AWWA C110, ductile iron, standard thickness.
 2. Joints: AWWA C111, rubber gasket joint devices.

2.2 SANITARY AND ROOF DRAINAGE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.
1. Fittings: Cast iron, ASTM A74.
 2. Joints: ASTM C564, rubber gasket joint devices or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hub-less, service weight.
1. Fittings: Cast iron, CISPI 301.
 2. Joints: CISPI 310, neoprene gaskets and stainless-steel clamp-and-shield assemblies.
- C. Copper Tube: ASTM B306, DWV.
1. Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.
 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
- D. Brass Pipe: ASTM B43, chrome plated.
1. Fittings: ASME B16.23, cast bronze, chrome plated.
 2. Joints: Mechanical compression.
- E. Steel Pipe: ASTM A53 Schedule 40, galvanized.
1. Fittings: Cast Iron, ASME B16.4, threaded fittings.
 2. Fittings: Malleable Iron, ASME B16.3, threaded type; ASTM A47.
 3. Joints: Threaded for pipe 2-inch and smaller; flanged for pipe 2½-inches and larger.
- F. Steel Pipe: ASTM A53 Schedule 40, galvanized, rolled grooved ends.
1. Fittings: ASTM A395 and ASTM A536 ductile iron, or ASTM A234 carbon steel, grooved ends.
 2. Joints: Grooved mechanical couplings meeting ASTM F1476.
 - a. Housing Clamps: ASTM A395/ and ASTM A536 ductile iron, hot dipped galvanized, compatible with steel piping sizes, rigid or flexible type.
 - b. Gasket: Elastomer composition for operating temperature range from 86 degrees F to 180 degrees F.
 - c. Accessories: Steel bolts, nuts, and washers.

2.3 UNIONS AND FLANGES

- A. Unions for Pipe 2-inches and Smaller:
1. Copper Piping: Class 150, bronze unions with soldered or brazed joints.
 2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

- B. Flanges for Pipe 2½-inches and Larger:
 - 1. Copper Piping: Class 150, slip-on bronze flanges.
 - 2. Gaskets: 1/16-inch-thick preformed neoprene gaskets.

2.4 FLOOR DRAINS

A. FD-1 Floor Drain (Toilet Rooms)

Coated cast-iron, light duty floor drain with round, nickel-bronze top; vandal-proof screws; adjustable to finished floor and ½” trap primer connection. Outlet type shall be suitable for the type of piping system provided. Provide floor drain with deep-seal P-trap.

Acceptable Manufacturers:

Josam	30000-A-50-VP
Jay R. Smith	2005-A-P050-U
Wade	1100STD-179
Zurn	ZN415B-P-VP

B. FD-2 Floor Drain (Mechanical Rooms)

Coated cast iron, medium duty floor drain with deep flange; adjustable, 8 ½” minimum diameter cast iron tractor grate and ½” trap primer connection. Outlet type shall be suitable for type of piping system provided. Provide floor drain with deep-seal P-trap.

Acceptable Manufacturers:

Josam	32100-AE-50
Jay R. Smith	2320-P050
Wade	1300
Zurn	Z525-P

C. FD-4 Floor Drain (Funnel)

Coated cast iron floor drain with 6-inch round nickel-bronze strainer, adjustable to finished floor - with 4 inch diameter nickel bronze funnel assembly. Outlet type shall be suitable for type of piping system provided. Provide floor drain with deep-seal P-trap.

Acceptable Manufacturers:

Josam	30000-A-F4
Jay R. Smith	2005-3580
Wade	1100STD6-EF4-1
Zurn	ZN-415B-4

2.5 INDIRECT DRAINS

A. IDW-1 Indirect Waste

Coated cast-iron indirect waste funnel. Provide with deep-seal P-trap (*).

Acceptable Manufacturers:

Josam	F52 (*)
Jay R. Smith	3812C (*)
Wade	2450EF
Zurn	Z326(*)

2.6 ROOF DRAINS

A. RD-1 Roof Drain (Large area)

Coated cast-iron body and membrane clamping flange; heavy-duty, round, cast iron bronze low profile top; vandal-proof screws; under deck clamp; sump receiver; extension for roof insulation (as required); adjustable to finished roof. Outlet type shall be suitable for the type of piping system provided.

Acceptable Manufacturers:

Josam
Jay R. Smith
Wade
Zurn

B. RD-2 Roof Drain (Small area - Canopies)

Coated cast-iron body and membrane clamping flange; heavy-duty, round, cast iron bronze low profile top; vandal-proof screws; under deck clamp; sump receiver; extension for roof insulation (as required). Outlet type shall be suitable for the type of piping system provided.

Acceptable Manufacturers:

Josam
Jay R. Smith
Wade
Zurn

2.7 CLEANOUTS (FCO)

A. Finished Floor Cleanouts: Coated cast-iron body, taper thread bronze plug, scoriated secured nickel bronze top. Cleanout shall have adjustable housing.

Acceptable Manufacturers:

Josam
Jay R. Smith
Wade
Zurn

- B. Tile Floors Cleanouts: Coated cast-iron body, taper thread bronze plug, with square top recessed for tile. Cleanout shall have adjustable housing.
Acceptable Manufacturers:
Josam
Jay R. Smith
Wade
Zurn
- C. Wall Cleanouts: Round stainless-steel wall access cover with center screw and recessed bronze tapped plug. Provide with threaded, coated cast iron cleanout tee.
Acceptable Manufacturers:
- | | |
|---------------|-------------|
| Josam | 58600-PLG |
| Jay. R. Smith | 4472T |
| Wade | 8480R-8590E |
| Zurn | ZS1468 |
- D. Exposed Piping Cleanouts: Recessed bronze threaded plug. Provide with threaded, coated cast iron cleanout tee.
Acceptable Manufacturers:
Josam
Jay R. Smith
Wade
Zurn

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection to existing piping system size, location, and invert as indicated on Drawings.
- B. Establish elevations of buried piping with not less than 2-feet of cover.
- C. Establish minimum separation of 10-feet horizontally and 18-inches vertically from other services in accordance with the latest edition of the North Carolina Plumbing Code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Excavate pipe trench in accordance with Sections 31 23 16 and 31 23 17.
- F. Install pipe to elevation as indicated on Drawings.
- G. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4-inches compacted depth; compact to 95 percent maximum density.
- H. Install pipe on prepared bedding.
- I. Route pipe in straight line.
- J. Install plastic ribbon tape continuous over top of pipe, buried 12-inches below finish grade, above pipeline; coordinate with Section 312323 and 31 23 17. Refer to Section 220553.
- K. Install trace wire continuous over top of non-metallic pipe. Refer to Section 220553.
- L. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section 312323.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.
 - 3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6-inches compacted layers to 12-inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 5. Do not use wheeled or tracked vehicles for tamping.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to comply with current code minimums unless noted otherwise on drawings. Maintain gradients.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide code required clearances at cleanout for snaking drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.

- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- F. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- G. Install piping to maintain headroom. Do not spread piping, conserve space.
- H. Group piping whenever practical at common elevations.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 210516.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 220700.
- K. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 099000.
- N. Install bell and spigot pipe with bell end upstream.
- O. Sleeve pipes passing through partitions, walls, and floors.
- P. Install fire-stopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 078400 and 22 05 29.
- Q. Support cast iron drainage piping at every joint.

3.5 FIELD QUALITY CONTROL

- A. Sections 01 40 00 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Test sanitary waste and vent piping system in accordance with applicable code.
- C. Video interior of all sanitary, grease waste, and storm drainage piping as outlined in paragraph 1.5.B of this section.

PIPE HANGER SPACING

PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
Cast Iron (All Sizes)	5	5/8
Cast Iron (All Sizes) with 10-foot length of pipe	10	5/8
Copper Tube, 1 1/4-inches and smaller	6	1/2
Copper Tube, 1 1/2-inches and larger	10	1/2
Glass	8	1/2
Polypropylene	4	3/8
Steel, 3-inches and smaller	12	1/2
Steel, 4-inches and larger	12	5/8

Note for Cast Iron Pipe: Provide close to joint on barrel. Also provide hanger at each change of direction and each branch connection.

END OF SECTION 221323

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SECTION 223130 – SUMP PUMP

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. The cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character, and quality of product desired; and that equivalent products will be acceptable.

1.2 SUMMARY

A. Section Includes:

- 1. Elevator Pit Sump Pump

B. Related Sections:

- 1. Division 03 - Cast-In-Place Concrete
- 2. Division 07 – Fire-stopping
- 3. Division 08 - Access Doors and Frames
- 4. Division 09 - Painting and Coating
- 5. Section 220503 - Common Electrical Requirements for Plumbing Equipment
- 6. Section 220548 – Seismic and Wind Controls for Plumbing Piping and Equipment
- 7. Section 220549 - Vibration and Sound Controls for Plumbing Piping and Equipment
- 8. Section 220553 - Identification for Plumbing Piping and Equipment
- 9. Section 221101 – Plumbing Piping
- 10. Section 221102 - General-Duty Valves for Plumbing Piping
- 11. Section 221103 - Plumbing Insulation
- 12. Section 221104 - Hangers and Supports for Plumbing Piping and Equipment
- 13. Section 221116 - Expansion Fittings and Loops for Plumbing Piping
- 14. Division 26 - Equipment Wiring Connections

15. Division 31 - Soils for Earthwork
16. Division 31 - Aggregates for Earthwork
17. Division 31 - Excavation
18. Division 31 - Trenching
19. Division 31 - Fill

1.3 REFERENCES

- A. Refer to Section 220501 for complete listing of references.

1.4 SUBMITTALS

- A. Section 220502 - Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Product Data:
 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 3. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves and equipment.
- C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Accept valves and equipment 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.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer warranty for pumps and controls.

1.12 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two pump seals for each pump model.

PART 2 - PRODUCTS

2.1 ELEVATOR PIT SUMP PUMP

- A. Provide pump(s) in formed concrete sump in elevator pit (by others) and as scheduled on Drawings.
- B. Motor shall be hermetically sealed; capacitor start type with built-in overload protection and Class B insulation.
- C. The pump shall be furnished with a compression type micro-pressure switch, bracket mounted on the pump and discharge pipe. The switch shall be suitable for either 110 volt or 208 volt, single phase operation and shall be furnished with ten (10)-feet of PVC cord and a "piggyback" combination grounded plug and receptacle.
- D. Bearings shall be factory sealed, grease lubricated, ball bearing type. Pump shaft shall be Type 303 stainless steel and shall utilize a mechanical seal arrangement. Pump impeller shall be of cast iron, bronze or phenolic construction and pump shall be furnished with a perforated steel plate strainer.
- E. The main control shall be approved to UL 508 standards and housed in a gasketed NEMA 4X enclosure with a see-through window for observation of operating functions. The control shall be equipped with an 8-pin twist lock receptacle, dual solid-state Oil-Minder relays with variable sensitivity settings, an over current relay, self-cleaning stainless steel sensor probe, high decibel warning horn with alarm silencing switch, dual floats, clearly marked terminal board and remote monitoring contact. A NEMA 4X junction box with 8-pin twist-lock electrical receptacle and 25-feet (additional lengths available in 25-foot increments) of mating 8-conductor cable shall be provided. All cables between the pump and junction box shall be 16-feet long and the cable and plug from the control unit shall be 8-feet long. The control unit, junction box, pump, floats and sensor shall be factory assembled as a complete, ready-to-use system and shall be tested and approved as a complete system by a nationally recognized testing laboratory such as ENTELA. The system shall allow for the main control to be located outside of the elevator hoist-way to be monitored for all functions without having to enter the elevator shaft.
- F. Approved Manufacturers:
 - 1. Myers Pump
 - 2. Weil Pump Company Series 1400
 - 3. Zoeller pump Flow-Mate Series
 - 4. Stancor Avenger Series SE

2.2 BUILDING AUTOMATION SYSTEM INTERFACE

- A. Provide auxiliary contacts in pump controllers for interface to Building Automation System. Output signal characteristics shall be 4-20 mAmp. Include the following:
 - 1. On-Off status of each pump

2. Alarm status

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION – PUMPS

- A. The drawings are diagrammatic in showing plumbing equipment layout. Variations in differing manufacturer's piping arrangements and physical equipment size require careful layout by the Contractor. The Contractor shall coordinate his layout so as to provide adequate clearances to allow for maintenance and inspection. In particular, equipment supports shall not obstruct floor drains or utility trench access and piping shall be installed to allow sufficient vertical clearance above equipment. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.
- B. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25-percent of midpoint of published maximum efficiency curve.
- C. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings.
- D. Install flexible connectors at or near pump where piping configuration does not absorb vibration.
- E. Provide line sized soft seat check valve and shut-off valve on pump discharge. Refer to Section 221102.
- F. Lubricate pumps before start-up.
- G. All equipment, piping and accessories shall be installed in strict accordance with manufacturer's requirements.
- H. Sump shall be vented through roof.
- I. Provide isolation valves for all equipment, and accessories.
- J. Unions shall be provided adjacent to all equipment or wherever necessary to facilitate the removal of equipment for repair or replacement. Unions for copper tubing up to and including

2-inches in diameter shall be brass ground joint with socket ends for solder. Unions for copper tubing 2½-inches in diameter and over shall be standard brass flanges with socket ends for solder. Flanges to be drilled for ASA Standard 125 lbs. flanges and so stamped. No lip type unions or long screws will be permitted. The Contractor shall furnish and install all structural steel angles, channels, etc. necessary to properly support all fixtures and equipment to the satisfaction of the Professional.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup check according to manufacturer's written instructions.
 - 2. Verify bearing lubrication.
 - 3. Disconnect couplings and check motor for proper direction of rotation.
 - 4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - 5. Verify that pump controls are correct for required application.
- B. Start pumps without exceeding safe motor power:
 - 1. Start motors.
 - 2. Open discharge valves slowly.
 - 3. Check general mechanical operation of pumps and motors.
- C. Test and adjust controls and safeties.
- D. Remove and replace damaged and malfunctioning components.
 - 1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
- E. Occupancy Adjustments: When requested within 12-months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two (2) visits to Project outside normal occupancy hours for this purpose.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 01 Section "Demonstration and Training."

3.6 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements; Division 01 - Execution and Closeout Requirements: Field

inspecting, testing, adjusting, and balancing.

END OF SECTION 223130

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SECTION 223401 – DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General requirements contained in Division 00 and 01 are a part of these Specifications.
- B. The cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character, and quality of product desired; and that equivalent products will be acceptable.

1.2 SUMMARY

A. Section Includes:

1. Electric water heaters.
2. Electric instantaneous water heaters.
3. Commercial gas-fired water heaters.
4. Domestic hot water storage tanks.
5. Flue Vents and Breeching.
6. Power Vents.
7. Expansion Tanks.

B. Related Sections:

1. Division 03 – Cast-in-Place Concrete: Execution requirements for concrete housekeeping pads specified by this section.
2. Section 220503 – Common Electrical requirements for Plumbing Equipment: Product requirements for pump motors for placement by this section.
3. Section 221101 – Plumbing Piping: Product and installation requirements for piping materials applying to various system types.
4. Section 221102 – General-duty Valves for Plumbing Piping for valve placement by this section.
5. Section 221103 - Plumbing Insulation: Field applied insulation for domestic water heaters.

6. Section: 22 24 01 - Domestic Water System and Specialties: Supply piping and connections to domestic water heaters.
7. Section 222423 - Natural-Gas System and Specialties: Execution requirements for gas piping connections specified by this section.
8. [Section 222433 - Liquid-Petroleum Gas System and Specialties: Execution requirements for gas piping connections specified by this section.]
9. [Section 227001 - Fuel-Oil System and Specialties: Execution requirements for fuel oil piping connections specified by this section.]
10. Division 23 - Breechings, Chimneys, and Stacks: Execution requirements for breeching, chimney, and stack connections to water heaters specified in this section.
11. Division 26 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.3 REFERENCES

- A. Refer to Section 220501 for complete listing of references.

1.4 SUBMITTALS

- A. Section 220502 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Shop Drawings: Indicate heater dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.
- C. Product Data:
 1. Water Heaters: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit electrical characteristics and connection locations.
- D. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.6 QUALITY ASSURANCE

- A. Conform to ASME Section VIII for construction of water heaters. Provide boilers registered

with National Board of Boiler and Pressure Vessel Inspectors.

DOE standard listed below applies to electric water heaters smaller than 40,000 Btuh , gas-fired storage water heaters smaller than 75,000 Btuh input, gas-fired instantaneous water heaters between 50,000 Btuh and 200,000 Btuh, oil-fired storage water heaters smaller than 105,000 Btuh, oil-fired instantaneous water heaters smaller than 210,000 Btuh. ANSI standard applies to larger capacities.

- B. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1 when tested in accordance with ANSI Z21.10.1.
- C. Perform Work in accordance with State standard.
- D. Maintain one (1) copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 – Administrative Requirements: Pre-installation meeting.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 – Product Requirements: Products storage and handling requirements.
- B. Accept water heaters on-site in original labeled cartons. Inspect for damage.
- C. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

1.12 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

- B. Furnish two pump seals.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Packaged water heater systems shall be furnished factory wired and UL listed. Final electrical connections shall be provided as indicated in Division 26.
- B. Storage tanks shall be insulated so that the maximum heat loss of the tank does not exceed 14 BTUH per square foot of tank surface area or the current ASHRAE 90-92 Standard, whichever is more stringent.
- C. Water heaters systems shall meet current ASHRAE 90A efficiency requirements.
- D. Packaged water heaters shall be National Sanitation Foundation certified and bear the NSF label.
- E. Provide the services of a manufacturer's representative experienced in the installation and operation of this equipment for not less than one workday on-site for installation inspection, startup, and instruction of owner's personnel.
- F. Provide water heaters as scheduled on Drawings.

2.2 ELECTRIC WATER HEATER

- A. Tank shall be designed for 150 psi working pressure. Water heater tank shall be covered with a year limited warranty against tank failure. Furnish pressure and temperature relief valve, shutoff valves on hot and cold water supplies and check stops.
- B. Unit shall be equipped with immersion "screw-in" elements, immersion thermostat, magnetic contactors; 120-volt control circuit with transformer and manual reset high temperature limit control. Large terminal block that accepts either CU or AL field connect wire, plus grounding lug for attaching an equipment grounding conductor. Transformer shall be part of this unit and all wiring.
- C. Capacity: Refer to Schedule on Drawings for Heater performance data.
- D. Approved Manufacturers:
 - 1. Bradford-White
 - 2. Ruud Water Heater Division
 - 3. State Industries
 - 4. A.O. Smith

2.3 ELECTRIC WATER HEATER (Instantaneous type)

- A. Wall mounted under counter instantaneous water heater.
- B. Capacity: Refer to Schedule on Drawings for Heater performance data.
- C. Approved Manufacturers:
 - 1. Chronomite
 - 2. In-Sink-Erator
 - 3. Eemax

2.4 COMMERCIAL GAS FIRED WATER HEATERS

- A. Type: Automatic, natural gas-fired, vertical storage.
- B. Capacity: Refer to Schedule on Drawings for Heater performance data.
- C. Tank: Glass lined welded steel; multiple flue passages, 4-inch diameter inspection port, thermally insulated with a minimum of 2-inches of glass fiber or polyurethane, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
- D. [Direct-vent flue: water heater(s) shall be suitable for sealed combustion direct venting using a 3" or 4" diameter CPVC exhaust pipe for a total distance of 50 ft or 120 ft equivalent feet of vent and 50 ft or 120 ft equivalent feet of intake.]
- E. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.
- F. Approval: By AGA as automatic storage water heater.
- G. Controls: Automatic direct immersion thermostat with temperature range adjustable minimum 175 degrees F differential. Automatic reset high temperature limiting thermostat factory set at 195 degrees F. Gas pressure regulator, multi-ribbon or tubular burner. Intermittent electronic ignition monitoring pilot and main flame, trial for re-ignition for momentary loss of flame, shut down of pilot and main burner in 2-4 seconds after loss of flame, and power vent with CPVC and PVC piping.
- H. Approved Manufacturers:
 - 1. A.O. Smith
 - 2. Bradford-White Corporation
 - 3. Laars Heating Systems Co.

2.5 EXPANSION TANK

- A. Provide expansion tank as scheduled on drawings

- B. Pre-pressurized diaphragm type steel expansion tank. Tank shall conform to ASME Section VIII construction for 125 psig, (200 psig WOG), tank shall have rigid polypropylene lining for corrosion control, butyl rubber diaphragm. Provide pressure gauge on system connection piping. (When system water pressure exceeds 80 psig provide a pressure regulating valve on the cold-water supply to the water heater.)
- C. Thermal expansion tank shall be installed to absorb expansion from hot water generator and storage tanks under no-flow or low-flow conditions. System connection shall be not located upstream of check valves or regulating valves or downstream of mixing valves or in a manner that shall negate this purpose.
- D. Thermal expansion tank pressurization shall be field charged to match the domestic water system pressure when pumps are energized but when water temperature in storage tank is at 40 to 80°F temperature. Acceptance volume shall be based upon the difference between system pressure and temperature relief valve pressure.
- E. Approved Manufacturers:
 - 1. Amtrol, Inc.
 - 2. Bell & Gossett
 - 3. Thrush
 - 4. Wessels Company

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The drawings are diagrammatic in showing plumbing equipment layout. Variations in differing manufacturer's piping arrangements and physical equipment size require careful layout by the Contractor. The Contractor shall coordinate his layout so as to provide adequate clearances to allow for maintenance and inspection. In particular, equipment supports shall not obstruct floor drains or utility trench access and piping shall be installed to allow sufficient vertical clearance above treatment tanks.
- B. Maintain manufacturer's recommended clearances around and over water heaters.
- C. Install water heater on concrete housekeeping pad, minimum 3½-inches (nominal 4-inches) high and 6-inches larger than water heater base on each side. Refer to Division 03.
- D. Provide isolation valves for all equipment, and accessories.
- E. Unions shall be provided adjacent to all equipment or wherever necessary to facilitate the removal of equipment for repair or replacement. Unions for copper tubing up to and including 2-inch diameter shall be brass ground joint with socket ends for solder. Unions for copper tubing 2½-inches in diameter and over shall be standard brass flanges with socket ends for solder. Flanges to be drilled for ASA Standard 125 lbs. flanges and so stamped. No lip type unions or long screws will be permitted. The Contractor shall furnish and install all structural steel angles, channels, etc. necessary to properly support all fixtures and equipment to the satisfaction of the Professional.

- F. Furnish and install an AGA/ASME pressure and temperature relief valve for each water heater.
- G. Connect natural gas piping in accordance with NFPA 54.
- H. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
- I. Connect domestic water piping to supply and return water heater connections.
- J. Install the following piping accessories. Refer to Section 222133.
 - 1. On supply:
 - a. Thermometer well and thermometer.
 - b. Strainer.
 - c. Pressure gage.
 - d. Shutoff valve.
 - 2. On return:
 - a. Thermometer well and thermometer.
 - b. Pressure gage.
 - c. Shutoff valve.
- K. Install the following piping accessories on natural gas piping connections. Refer to Section 222423.
 - 1. Strainer.
 - 2. Pressure gage.
 - 3. Shutoff valve.
 - 4. Pressure reducing valve.
- L. Install discharge piping from relief valves and drain valves to nearest floor drain.
- M. Install circulator and diaphragm expansion tank on water heater.
- N. Install water heater trim and accessories furnished loose for field mounting.
- O. Install electrical devices furnished loose for field mounting.
- P. Install control wiring between water heater control panel and field mounted control devices.

- Q. Connect flue to water heater outlet, full size of outlet. Refer to Division 23.
- R. Connect combustion air intake per manufacturer's requirements to water heater outlet, full size of outlet.
- S. Domestic Hot Water Storage Tanks:
 - 1. Provide steel pipe support, independent of building structural framing members.
 - 2. Clean and flush prior to delivery to site. Seal until pipe connections are made.
- T. Install Work in accordance with State and Municipality standards.

END OF SECTION 223401

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SECTION 224001 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. The cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character and quality of product desired; and that equivalent products will be acceptable.

1.2 SUMMARY

- A. Section Includes:
 - 1. Water closets
 - 2. Lavatories
 - 3. Sinks
 - 4. Service sinks and mop basins
 - 5. Electric water coolers
 - 6. Showers
 - 7. Hose bibbs
 - 8. Wall hydrants
- B. Related Sections:
 - 1. Division 07 - Joint Protection: Product requirements for caulking between fixtures and building components for placement by this section.
 - 2. Section 222401 - Domestic Water System and Specialties
 - 3. Section 222501 - Sanitary Waste and Vent System and Specialties
 - 4. Division 26 - Equipment Wiring Connections

1.3 REFERENCES

- A. Refer to Section 220501 for complete listing of references.

1.4 SUBMITTALS

- A. Section 220502 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Product Data: Submit catalog illustrations of fixtures, sizes, rough in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Installation Instructions: Submit installation methods and procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with North Carolina Building Code - Plumbing standard.
- B. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., as suitable for purpose specified and indicated.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.10 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for plumbing fixtures.

1.11 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two sets of faucet washers, flush valve service kits, lavatory supply fittings, shower heads and toilet seats.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All fixtures shall be furnished complete with traps, faucets, wastes, supplies with stops, etc., as required. All exposed metal parts shall be chromium plated.
- B. All fixtures and equipment of similar types shall be of the same manufacturer unless indicated otherwise on the drawings or specified herein.
- C. Fixtures shall be mounted at mounting heights as indicated.
- D. If fixtures and equipment indicated in the Contract Documents are not currently manufactured, the manufacturer's current equivalent to the indicated fixtures and equipment shall be provided at no additional cost, subject to review and acceptance by the Professional.

2.2 WATER CLOSETS

- A. P-1 Water Closet (ADA Accessible, Floor Mounted with Hard Wired Powered Dual Flush Valve)

White vitreous china, floor mounted, siphon jet, elongated bowl with 1-1/2-inch top spud. Water closet shall be mounted as required. Water closet shall be provided with an extra heavy duty, elongated, white plastic seat with an open front and self-sustaining stainless steel check hinges and mounting hardware. Flush valve shall be a dual flush, hard-wired, electronic, vandal-proof, water-saver type and shall use a maximum of 1.28 gallons per flush. Provide with manufacturer required transformer.

FIXTURE

American Standard FloWise
Kohler
Crane
Moen

FLUSH VALVE (Diaphragm type - 1.28 gpf)

Sloan 111 DFSM; Hard Wired, Electronic, Dual Flush
Zurn
American Standard

SEAT

Centoco
Beneke
Church
Bemis
Olsonite

2.3 LAVATORIES

A. P-2 Lavatory (Wall hung - Barrier Free)

White Vitreous China Lavatory with Overflow, single faucet hole, Drilled For Concealed Arm Carriers. Provide Lavatory Complete with Floor Mounted Carrier, Provide complete with fixture mounted single hole faucet, sensor type, electronic, 0.5 gpm flow control and vandal resistant aerator, chrome plated semi-cast brass P-Trap, chrome plated supplies with heavy-duty, 1/2-inch IPS x 3/8-inch O.D. loose key stops, chrome plated brass grid strainer with offset tailpiece and insulation kit for p-trap and supplies. Provide with faucet manufacturer required transformer. Nominal dimensions shall be 20-inches by 18-inches.

FIXTURE

American Standard "Lucerne"
Kohler
Crane
Moen

FAUCET

Sloan ETF80 4BDM Series
Chicago
Zurn

CARRIER

Josam
Jay R. Smith
Wade

Zurn or approved equivalent

B. SINKS

P-3 Mop Receptor (Rectangular)

24-inch x 24-inch x 10-inch high one-piece molded stone. Mop receptor shall be furnished

complete with 3-inch drain with removable chrome plated strainer, vinyl or stainless-steel bumper guard, and faucet with vacuum breaker, support rod, pail hook, adjustable spacing faucet inlets with integral stops and checks; stainless steel wall guards.

FIXTURE

Fiat MSBID-2424
Florestone
Mustee

FAUCET

Fiat 830-AA
Chicago
Speakman
T & S Brass

C. P-4 Handwash Sink (Wall hung)

White Vitreous China Lavatory with Overflow, Drilled For Concealed Arm Carriers. Provide Lavatory Complete with Floor Mounted Carrier, Provide complete with deck mounted gooseneck spout, 0.5 gpm flow control and vandal resistant laminar flow outlet, chrome plated semi-cast brass P-Trap, chrome plated supplies with heavy-duty, ½-inch IPS x 3/8-inch O.D. loose key stops, chrome plated brass grid strainer with offset tailpiece and insulation kit for p-trap and supplies. Nominal dimensions shall be 20-inches by 18-inches.

FIXTURE

American Standard "Lucerne"
Kohler
Crane
Moen

FAUCET

Chicago 786-E2805-5XKABCP with Foot Pedal Operation where shown on plans
Delta
Zurn

CARRIER

Josam, Jay R. Smith, Wade, Zurn or approved equivalent

D. P-5 Handwash Sink (Single Compartment)

Nominal 19-inch x nominal 18-inch x 5.5-inch deep, self rimming single compartment sink. Sink shall be fully sound-deadened, eighteen (18) gauge, Type 304 stainless steel. Faucet shall have a rigid-swing gooseneck type faucet with 4-inch wrist blade handles. Provide sink complete with chrome plated semi-cast brass P-trap with cleanout, chrome plated brass waste to wall with chrome plated brass escutcheon, stainless steel perforated grid strainer with chrome

plated brass tailpiece; chrome plated supplies with heavy-duty chrome plated ½" IPS x ½" O.D. wheel handle supply stops with escutcheons. The Contractor shall provide a template to allow preparation of casework opening.

FIXTURE

Elkay "Lustertone"
Just "Stylist"
Advance Tabco

FAUCET

Chicago 786-E2805-5XKABCP
Delta
Speakman
T & S Brass

E. P-6 Utility Sink (Single Compartment)

Nominal 22-inch x nominal 19.5-inch x 6.5-inch deep, self rimming single compartment sink. Sink shall be fully sound-deadened, eighteen (18) gauge, Type 304 stainless steel. Faucet shall have a rigid-swing gooseneck type faucet with 4-inch wrist blade handles. Provide sink complete with chrome plated semi-cast brass P-trap with cleanout, chrome plated brass waste to wall with chrome plated brass escutcheon, stainless steel perforated grid strainer with chrome plated brass tailpiece; chrome plated supplies with heavy-duty chrome plated ½" IPS x ½" O.D. wheel handle supply stops with escutcheons. The Contractor shall provide a template to allow preparation of casework opening.

FIXTURE

Elkay "Lustertone"
Just "Stylist"
Advance Tabco

FAUCET

Chicago 895-200181AB
Delta
Speakman
T & S Brass

F. P-7 2 Basin Utility Sink (Rectangular)

Advance Tabco Model DI-2-1410, Stainless Steel Sink, Countertop Mounted, 33-1/2"x21", 10" deep, Double Bowl Sink. Provide Chicago Faucet Model 895-317GN8AE29VAB, 1.5 Gpm Deck Mounted 8" Gooseneck Spout with Wrist Blade Handles And Non-Aerating Laminar Flow Outlet. Provide Chrome Plated Brass P-Traps And 1/4-Turn Shut-Off Supplies.

FIXTURE

Advance Tabco DI-2-1410
Elkay
Just

FAUCET

Chicago 895-317GN8AE29VAB
Speakman
T & S Brass

G. P-8 3 Basin Utility Sink (Rectangular)

Advance Tabco Model DI-3-1410, Stainless Steel Sink, Countertop Mounted, 50"x21", 10" deep, Triple Bowl Sink. Provide two (2) Chicago Faucet Model 895-317GN8AE29VAB, 1.5 Gpm Deck Mounted 8" Gooseneck Spouts with Wrist Blade Handles And Non-Aerating Laminar Flow Outlets. Provide Chrome Plated Brass P-Traps And 1/4-Turn Shut-Off Supplies.

FIXTURE

Advance Tabco DI-3-1410
Elkay
Just

FAUCETS

Chicago 895-317GN8AE29VAB
Speakman
T & S Brass

H. P-9 Lab Sink (Rectangular) with Eyewash

Orion Model ARLS-17, Corrosion Resistant Lab Sink, Countertop Mounted, 23"Wx18"Lx12"D, Single Bowl Sink. Provide Chicago Faucet Model 895-200181AB, 1.5 Gpm Deck Mounted 8" Gooseneck Spout With Wrist Blade Handles And Non-Aerating Laminar Flow Outlet. Provide Chrome Plated Brass P-Trap And 1/4-Turn Shut-Off Supplies. Provide With Guardian G0522 Deck Mounted Eyewash And Guardian G6020 Thermostatic Mixing Valve.

FIXTURE

Orion ARLS-17
Florestone
Mustee

FAUCET

Chicago 895-200181AB

Speakman
T & S Brass

I. P-10 Kitchen Sink (Single Compartment)

Nominal 22-inch x nominal 19-inch x 5.5-inch deep, self rimming single compartment sink. Sink shall be fully sound-deadened, eighteen (18) gauge, Type 304 stainless steel. Faucet shall have a rigid-swing gooseneck type faucet with 4-inch wrist blade handles. Provide sink complete with chrome plated semi-cast brass P-trap with cleanout, chrome plated brass waste to wall with chrome plated brass escutcheon, stainless steel perforated grid strainer with chrome plated brass tailpiece; chrome plated supplies with heavy-duty chrome plated ½" IPS x ½" O.D. wheel handle supply stops with escutcheons. The Contractor shall provide a template to allow preparation of casework opening.

FIXTURE

Elkay "Lustertone"
Just "Stylist"
Advance Tabco

FAUCET

Chicago 895-200181AB
Delta
Speakman
T & S Brass

2.4 ELECTRIC WATER COOLERS

A. EWC Electric Water Cooler with Bottle Fill Station (Bi-level Type - Barrier Free)

Dual height, wall mounted, with floor carrier, stainless steel enclosure, electric water coolers with two (2) one-piece bubblers, self-closing push-button operators. Coolers shall have a minimum capacity of eight gallons per hour (8 gallons per hour) at ARI standard conditions. Cooler shall be provided complete with heavy-duty ½"IPS x 3/8"O.D. wheel handle supply stop, chrome plated semi-cast brass P-trap with cleanout plug. Waste piping shall be insulated from drain to wall rough-in. Coordinate High / Low arrangement with Architectural requirements. Color shall be as selected by the Professional. Provide with Bottle Fill Station.

FIXTURE

Halsey Taylor HTHB-HAC8BLPV-WF
Elkay
Oasis

CARRIER

Josam, Jay R. Smith, Wade, Zurn or approved equivalent

2.5 HOSE BIBBS AND WALL HYDRANTS

A. HB-1 Hose Bibb

Angle pattern hose bibb; chrome plated brass body, vacuum breaker-backflow preventer with 3/4-inch male hose thread nozzle, tee-handle and 3/4-inch copper water tube inlet.

Acceptable Manufacturers:

Chicago
Wolverine Brass
Woodford

B. FPWH-1 Wall Hydrant (Non-Freeze in Wall Box)

Concealed type, freeze-proof, automatic draining wall hydrant consisting of a stainless steel or cast bronze wall box and door with chrome finish; vacuum breaker-backflow preventer with 3/4-inch male hose thread nozzle; bronze or stainless-steel operating stem; 3/4-inch copper water tube inlet and wall clamp. A loose tee key shall be furnished with each wall hydrant. Verify wall thickness requirements for each location required.

Acceptable Manufacturers:

Jay R. Smith
Josam
Wade
Zurn
Woodford

2.6 LAVATORY INSULATION KIT

A. Manufacturers:

1. Plumberex
2. Skal-Gard
3. Truebro

B. Product Description: Where Lavatories are noted to be insulated for ADA compliance, furnish the following: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Fixtures and equipment shall be installed in a neat and workmanlike manner and in accordance with the manufacturer's recommendations. The quality of installation shall be subject to the approval of the Professional.
- B. All wall mounted fixture carriers and supports shall be suitable to the type of construction wherein they are located. Urinals shall be supported by chair carriers. Lavatories shall be supported by floor mounted carriers. Install anchor bolts in all available anchor locations.
- C. All fixtures and equipment must be protected against damage during the progress of construction. Upon completion of construction, all fixtures and equipment must be thoroughly cleaned and left in perfect working order. All piping and accessories having polished, plated or finished surfaces shall be protected to prevent scarring or other damage and protect the finish against damage.
- D. Provide isolation valves for all fixtures, equipment, and accessories.
 - 1. Exception: Omit stop valves on supplies to emergency equipment, except where permitted by authorities having jurisdiction. When permitted, install valve and locked in OPEN position.
- E. All fixture supplies and waste lines shall be run to wall unless construction requires they be run to floor. All supplies through walls shall be provided with angle stops. All supplies through floors shall be provided with straight stops. Unions shall be provided adjacent to all equipment or wherever necessary to facilitate the removal of equipment for repair or replacement. Unions for copper tubing up to and including 2-inch diameter shall be brass ground joint with socket ends for solder. Unions for copper tubing 2½-inches in diameter and over shall be standard brass flanges with socket ends for solder. Flanges to be drilled for ASA Standard 125 pounds flanges and so stamped. No lip type unions or long screws will be permitted. The Contractor shall furnish and install all structural steel angles, channels, etc. necessary to properly support all fixtures and equipment to the satisfaction of the Professional.
- F. Drain piping from all backflow preventers, relief valves and vents, drain down connections, kitchen equipment, etc. shall be extended to within 4-inches of a floor sink or floor drain.

- G. Mop receptors drains shall be sized for the outlet pipe size shown on drawings and shall be equipped with deep-seal P-traps. The Contractor shall be responsible for proper height setting and leveling of drains. Set mop receptors in leveling bed of cement.
- H. Water closet floor flanges shall be cast iron, screwed or caulked, not less than ¼-inch thick; not less than 2-inches caulking depth. Bolted with approved gasket between closet bowl and flange. Closet screws shall be of brass. The use of commercial putty or plaster for setting closet bowls is prohibited.
- I. Apply a bead of sanitary-type, 1-part mildew resistant, silicone sealant around the edge of surface mounted plumbing fixture to mask any irregularities between the fixture and wall finish. Color of sealant shall match the fixture color.

3.4 COLUMN SHOWERS

- A. Column showers shall be positioned so that a shower head is not facing the entrance to the shower area.

3.5 MOUNTING HEIGHTS

- A. Plumbing fixture mounting heights shall be as indicated on the drawings. Mounting heights for barrier free fixtures shall meet the requirements of the ADA Accessibility Guidelines. These guidelines shall apply unless superseded by more stringent State or Local requirements.

3.6 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.7 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.8 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Clean plumbing fixtures and equipment.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 - Execution and Closeout Requirements: Protecting installed construction.
- B. Do not permit use of fixtures before final acceptance.

END OF SECTION 224001

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SECTION 226013 - MEDICAL GAS AND VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.

1.2 SUMMARY

A. Section Includes:

1. Medical Gas Piping
2. Pipe Hangers and Supports
3. Piping Specialties
4. Medical Gas Outlets
5. Ceiling Services
6. Alarm controls and panels
7. Pressure Switches
8. Manifolds
9. Medical Vacuum Pump Source System
10. Labeling and Identification
11. Installer Performed Tests
12. System Verification Tests

1.3 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
3. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. American Society of Sanitary Engineering:

1. ASSE 6010 - Professional Qualification Standard for Medical Gas and Vacuum System Installers.
2. ASSE 6020 – Professional Qualifications Standard for Medical Gas Systems Inspectors
3. ASSE 6030 - Medical Gas Verifiers Professional Qualification Standard.

C. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS B2.2 - Standard for Brazing Procedure and Performance Qualifications.
3. AWS D1.1 - Structural Welding Code - Steel.

D. ASTM International:

1. ASTM B32 - Standard Specification for Solder Metal.
2. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
3. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
4. ASTM B819 - Standard Specification for Seamless Copper Tube for Medical Gas Systems.
5. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
6. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

E. Compressed Gas Association:

1. CGA G-4.1 - Cleaning Equipment for Oxygen Service.
2. CGA V-1 - Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections.
3. CGA V-5 - Diameter-Index Safety System (Non-Interchangeable Low Pressure Connections for Medical Gas Applications).

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

3. MSS SP 73 - Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings.
4. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

G. National Fire Protection Association:

1. NFPA 50 - Standard for Bulk Oxygen Systems at Consumer Sites.
2. NFPA 99 - Health Care Facilities.

H. Underwriters Laboratories Inc.:

1. Electrical Construction Equipment.

1.4 SYSTEM DESCRIPTION

Category 1 Medical Piped Gas and Vacuum Systems: Systems where interruption would place patients in immediate danger, major injury or death.

Category 1 Vacuum Systems: Monitored system with station outlets for patient suction.

A. Category 1 Medical Gas Systems include the following gas types, piping systems and equipment.

B. Gases:

1. Medical Air
2. Oxygen.
3. Medical-surgical vacuum.
4. Instrument Air

C. Piping Systems:

1. Level 1 positive pressure medical gas system piping.
2. Level 1 medical-surgical vacuum system piping.

D. Equipment:

1. Medical gas outlets.

1.5 SUBMITTALS

A. Division 00 and 01 Submittal Procedures.

- B. Shop Drawings:
 - 1. Indicate piping system schematic with electrical and connection requirements general assembly of components, mounting and installation details.
 - 2. Indicate general layout of control and alarm panels.
 - 3. Indicate detailed medical wall assembly drawings.
- C. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - 4. System Components: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes. When applicable, include electrical characteristics and connection requirements.
- D. Product Data: Submit manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
- E. Qualifications Data: Submit documentation verifying qualifications for the following:
 - 1. Brazers and brazing procedures.
 - 2. Welders and welding procedures.
 - 3. Medical gas and vacuum system installer.
 - 4. System verifier.
- F. Manufacturer's Installation Instructions: Submit hoisting and setting requirements, starting procedures.
- G. Manufacturer's Certificate:
 - 1. Certify piping materials comply with CGA G-4.1 cleaning requirements.
- H. Manufacturer's Field Reports: Indicate systems are complete, zone valves installed, and alarm systems functional.
- I. Installer's Test Reports:

1. Submit documentation indicating completion of Installer Performed Tests.
2. Submit list of each test and when test was completed.
3. Include documentation required by NFPA 99.

J. Verifier's Test Reports:

1. Submit testing and inspection report of System Verification Tests.
2. Submit list of each test and when test was completed.
3. Include documentation required by NFPA 99.

1.6 CLOSEOUT SUBMITTALS

1. Project Record Documents: Record actual locations of equipment piping, valves, outlets and components.
2. Operation and Maintenance Data: Submit assembly views, lubrication instructions, replacement part numbers and availability.

1.7 QUALITY ASSURANCE

- A. Furnish piping, valves, pipe fittings, outlets and other piping components cleaned for oxygen service by manufacturer in accordance with CGA G-4.1.
- B. Furnish documentation certifying installed piping materials comply with CGA G-4.1 cleaning requirements.
- C. Perform Work in accordance with NFPA 99 for installation of piping systems and for brazing materials and procedures.
- D. Perform Work in accordance with authority having jurisdiction for welding hanger and support attachments to building structure.
- E. Perform Work in accordance with State of North Carolina standard.
- F. Maintain two (2) copies of each document on site.

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 five years documented experience.
 - 1. ASSE Standard 6010 qualified to install medical gas and vacuum systems.
- C. Brazers and Brazing Procedures: AWS B2.2 qualified within previous 12 months for medical gas and vacuum systems.
- D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months for medical gas and vacuum systems.
- E. System Inspector: Company specializing in performing medical gas system inspector with minimum five years documented experience approved by Architect/Engineer.
 - 1. ASSE Standard 6020 qualified and independent of system inspector.
- F. System Verifier: Company specializing in performing medical gas system verification with minimum five years documented experience approved by Architect/Engineer.
 - 1. ASSE Standard 6030 qualified and independent of system verifier.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept equipment on site in factory fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of equipment system for one year from Date of Substantial Completion.
- B. Perform work without removing equipment system or components from service during building normal occupied hours.

- C. Provide emergency call back service at all hours during working hours for this maintenance period.
- D. Maintain locally, near Project location, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- E. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of original installer.
- F. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.11 EXTRA MATERIALS

- A. Furnish two of each spring, poppet, and O-ring for each type of medical gas outlet.

1.12 COORDINATION

- A. Medical Gas Contractor shall coordinate with other trades to ensure timely installations and avoid conflicts and interference.
- B. Work with metal stud partition installer and/or mason to ensure anchors, sleeves and similar items are provided in sufficient time to avoid delays; chases and openings are properly sized and prepared.
- C. Coordinate with owner to ensure medical gas outlets, whether owner supplied or contractor supplied, in walls, ceiling and all equipment is provided by the same Medical Gas Equipment Manufacturer (MGEM) satisfactory to the owner.
- D. Coordinate with bulk cryogenic gas supplier for installation, connection and verification of bulk gas supply systems.
- E. Medical Gas Contractor shall supply and install the master alarm system, including the signal wiring. The electrical contractor shall provide power wiring to each alarm panel. Medical Gas Contractor is responsible for proper termination, testing and marking of alarm panels. Termination shall be done by or under supervision of manufacturer of alarm panels.
- F. Coordinate with Medical Gas Verifier to deliver a complete, tested medical gas installation ready for owner's use.

PART 2 - PRODUCTS

2.1 POSITIVE PRESSURE MEDICAL GAS SYSTEM TUBING AND FITTINGS

- A. Piping All Sizes, Below Gage Pressure of 185 psig:

1. Copper Tubing: ASTM B819, Type L or K, drawn.
- B. Piping 2-1/2 inches (65 mm) and Smaller, Above Gage Pressure of 185 psi:
 1. Copper Tubing: ASTM B819, Type L or K, drawn. Include standard color marking "OXY", "MED", "OXY/MED", "ACR/OXY", or "ACR/MED" in green for Type K and blue for Type L.
- C. Fittings: Factory cleaned, purged, and bagged for oxygen service according to ASTM B 819 or field cleaned, purged, and bagged as specified in "Preparation" Article in Part 3. ASME B16.22, wrought copper and bronze or MSS SP 73 wrought and cast copper.
- D. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.
- E. Isolation of copper tubing from dissimilar metals shall be accomplished either through use of copper or copper plated hangers or hangers with plastic isolators.

2.2 MEDICAL-SURGICAL VACUUM TUBING AND FITTINGS

- A. Copper Tubing: [ASTM B819] [ASTM B88 (ASTM B88M), Type L or K, drawn ASTM B280].
 1. Fittings: ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
 3. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.
- B. Isolation of copper tubing from dissimilar metals shall be accomplished either through use of copper or copper plated hangers or hangers with plastic isolators.

2.3 BALL VALVES

- A. Manufacturers:
 1. Allied Health Care Model 77-03-XXXX Series.
 2. Amico Corporation Model V-X-VLV-NIB Series.
 3. Beacon Medical Products Model 6-230778 Series.
- B. 2 inches and Smaller: MSS SP 110, Class 150, bronze, three piece body, chrome plated bronze ball, full port, teflon seats, blow-out proof stem, solder or threaded ends, lever or locking lever handle.

1. Furnish valves cleaned for oxygen service in accordance with CGA G-4.1 by manufacturer and labeled, sealed, and packed for shipping.

- C. Locks: Furnish color coded cable lock or padlock matching existing keying system. Locking mechanism shall have a minimum ¼-inch diameter hole. Color code valve tags and locks as follows:

1. O2 – Green
2. NO – Brown
3. N2 – Black
4. WAGD – Purple
5. Vacuum - White

2.4 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:

1. Copper B Line
2. Creative Systems Inc.
3. Flex-Weld, Inc.
4. Glope Pipe Hanger Products Inc.
5. Michigan Hanger Co.
6. Superior Valve Co.

- B. Conform to MSS SP 58.

- C. Furnish hangers for copper piping system with copper finish and sized for copper pipe.

2.5 MEDICAL GAS OUTLETS

- A. Manufacturers:

1. Allied Health Care
2. AMICO Corporation
3. Beacon Medaes Products

- B. Style: Medical gas outlet stations shall be Amico Alert-1 series (Chemetron Compatible or D.I.S.S. as noted).
- C. Location: Wall and Ceiling
- D. Mounting: Flush
- E. Furnish outlets with the following features:
 - 1. For positive pressure gas services, the outlet shall be equipped with a primary and secondary check valves with secondary check valve rated at a maximum of 200 psi, and capped 3/8-inch nominal size copper inlet pipe stub with silver brazed to outlet body for supply connections, color coded and labeled faceplates with outlet box for intended service.
 - 2. Nitrogen outlet latch-valve assemblies and ceiling outlets shall be D.I.S.S. and shall only accept corresponding gas specific adapters. All other outlets, unless noted otherwise, shall be Quick Disconnect compatible and shall only accept corresponding gas specific adapters.
 - 3. Furnish outlets cleaned for oxygen service by manufacturer and labeled, sealed, and packed for shipping.
 - 4. Outlets shall be of modular design and include gas specific steel mounting plate to permit on-site ganging of multiple outlets, in any order.
- F. Vacuum Bottle Brackets: Stainless steel, chrome-plated metal, or aluminum with finish matching adjacent outlet.
- G. Outlet Rough-in: Flush mounted, protected against corrosion. Anchor rough-in securely to unit or wall construction.
- H. Modular Cover Plate: Die cast back plate, two-piece 22 gage stainless steel or 16 gage chromium plated metal, with mounting flanges on all four sides, secured to rough-in with stainless steel or chromium plated countersunk screws.

2.6 CEILING SERVICES

- A. Medical Gas Outlets and accessories:
 - 1. D.I.S.S. outlets, similar to that specified under Article 2.5 MEDICAL GAS OUTLETS.
 - 2. Hose Assemblies: Provide with assemblies manufactured with FDA approved medical grade thermoplastic conductive rubber tubing. The tubing shall be reinforced with polyester yarn reinforcement.
 - a. Tube shall be color coded to conform with CGA C-9 standards with fittings permanently crimped on each end with ferrules.

2.7 ALARMS

- A. Provide all low voltage control wiring, except for wiring from alarm relay interface control cabinet to ECC, required for complete, proper functioning system.
- B. Alarm Functions:
 - 1. Oxygen, nitrous oxide, carbon dioxide and compressed air alarms: Pressure alarms: Functions when pressure in branch drops below 40 psi, ± 2 psi or increases above 60 psi, ± 2 psi set points; operated by pressure switches or transmitters.
 - 2. Nitrogen alarms: Pressure alarms: Functions when pressure in branch drops below 190 psi, ± 2 psi or increases above 220 psi, ± 2 psi set points; operated by pressure switches or transmitters
 - 3. Vacuum alarms: Low vacuum alarm: Functions when vacuum in branch drops below 12-inches Hg; operated by vacuum switch.
 - 4. Waste Anesthetic Gas Disposal (WASG) low alarm: Functions when WAGD vacuum level or flow is below effective operating limits.
- C. Master Alarm Panels
 - 1. Master Alarm panels shall comply with NFPA 99.
 - 2. Master alarms shall come with a five-year parts warranty.
 - 3. Master alarm panel shall be equivalent to Amico Alert-4 LCD Ethernet series.
 - 4. The master alarm shall be microprocessor based and field adjustable.
 - 5. General: Modular design, easily serviced and maintained; alarms operate on alternative current low voltage control circuit; provide required number of transformers for efficient functioning of complete system. Alarm panels shall be integral units, reporting gas, compressed air and vacuum services, as required.
 - 6. Box: Flush mounted, sectional or one piece, corrosion protected. Size to accommodate required number of service functions for each location, and for one audible signal in each box. Anchor box securely. Provide spare capacity to accommodate 50% of the number of provided alarm points.
 - 7. The alarm shall update its status every second.
 - 8. The LCD Alarm shall be capable of displaying an exact replica of the alarm on a computer screen via the facility's ethernet or internet connectivity. It shall also be capable of duplicate display on mobile device with enabled audio alarm triggers.
 - 9. The system shall be capable of unlimited trend/history logging of alerts for troubleshooting.

10. Alarm channels shall be in normally open or normally closed positions. The device channels will indicate a green “NORMAL” and a red “HIGH” or “LOW” alarm/fault condition.
11. Monitor the following source (remote) conditions:
 - a. Medical Air Cylinder Supply:
 - 1) Medical Air Main Line Pressure High.
 - 2) Medical Air Main Line Pressure Low.
 - 3) Medical Air Changeover to Secondary Supply.
 - 4) Medical Air Dew Point High.
 - b. Oxygen Cylinder Supply:
 - 1) Oxygen Main Line Pressure High.
 - 2) Oxygen Main Line Pressure Low.
 - 3) Oxygen Changeover to Secondary Supply.
 - c. Medical Vacuum System:
 - 1) Vacuum Lag Pump In Use.
 - 2) Main Line Vacuum Low.
 - 3) Local Alarm.
 - d. Local Alarm.

D. Area Alarm Panels:

1. Area Alarm panels shall comply with NFPA 99.
2. Area alarms shall come with a five-year parts warranty.
3. Area alarm panel shall be equivalent to Amico Alert-4 LCD Ethernet series.

4. Area alarms shall consist of multiple sensors, gauges, indicators, and a display.
5. Input power to the area alarm shall be 115-220 V, 50-60 Hz.
6. Sensors for area alarms may be either locally mounted or remotely mounted.
7. The LCD Alarm shall be capable of displaying an exact replica of the alarm on a computer screen via the facility's ethernet or internet connectivity. It shall also be capable of duplicate display on mobile device with enabled audio alarm triggers.
8. The system shall be capable of unlimited trend/history logging of alerts for troubleshooting.
9. Each sensor unit is gas specific, with an error message display for an incorrect connection.
10. Each gas service shall be provided with a digital read-out comprising of 0-249 psi for pressure and 0-30"Hg for vacuum. The digital read-out shall provide a constant indication of each service being measured. It will indicate a green "NORMAL" and a red "HIGH" or "LOW" alarm condition.
11. If an alarm occurs, the green indicator shall change to red and a continuous audible alarm will sound. Pushing the mute button will cancel the audible alarm, but the unit will remain in the alarm condition until the problem is rectified.
12. The default set-points shall be +/- 20% variation from normal condition. In the calibration mode High/Low set-points shall be adjustable.
13. Area alarms shall have a self-diagnostic and error message display for ease of maintenance.
14. The box shall be fabricated from 18-gauge steel with a 1/4" I.D. type "K" copper pipe for connection to the service line.
15. Monitor the following abnormal conditions:
 - a. High line pressure (for each medical gas).
 - b. Low line pressure (for each medical gas).
 - c. Low medical-surgical vacuum.
 - d. Low WAGD vacuum.
 - e. Backup vacuum pump in operation.
 - f. Backup instrument air compressor in operation.

g. Medical air system high dew point.

h. Instrument air system high dew point.

E. Pressure Switches:

1. General purpose, contact or mercury type, allowing both high and low pressure set points, with contact type provided with a protective dust cover; adjustable range set by inside or outside adjustment; switches activate when indicated by alarm requirements. Use one orifice nipple (or DISS demand check valve) for each sensor or pressure switch.

F. Zone Valve Box (Multiple Sensor Indicator Panel):

1. Zone Valve Boxes shall comply with NFPA 99. The valve box shall be constructed of 18 gauge steel, complete with a baked white enamel finish. Affixed to the opposite sides of the box will be two adjustable steel brackets for the purpose of mounting the box to the structural support. The steel brackets shall accommodate various finished wall thicknesses between 3/8" and 1-3/16" and shall be field adjustable. The frame assembly shall be constructed of anodized aluminum and shall be mounted to the back box assembly by standard #6 x 3/8" tapping screws as provided.
2. Gauge options shall be selected for the medical gas/vacuum served. Terminal strips to be provided with the box. Valve box shall have integral alarm sensor. The sensors and DISS fittings shall be gas specific.
3. The removable front shall consist of an opaque window with a pullout ring pre-mounted to the center of the window. Access to the zone shut-off valves shall be by merely pulling the ring assembly to remove the window from the frame. The window can be reinstalled without the use of tools only after the valve handles have been returned to the open position. The window shall be marked to prohibit unauthorized persons from tampering with the valves with the following silk-screen caution: "MEDICAL GAS CONTROL VALVES. CLOSE ONLY IN EMERGENCY"
4. Each valve shall be supplied with an identification bracket which shall be bolted directly onto the valve box for the purpose of applying an approved medical gas identification label. A package of labels shall be supplied with each valve box assembly for application by the installer.
5. The front panel shall be labelled to instruct persons to close the valves only in an emergency. The valve box shall be constructed so that the front panel cannot be attached to the box while any valve inside is in the closed position. Openings to the box's interior shall be dust-tight.
6. Each pipe inside the box shall come with its own pressure gauge that can be viewed through the clear window. All gases and their respective gauges shall be clearly labelled with the proper color coordination as per NFPA 99.

7. Access to the zone shut-offs shall be pulling the ring assembly to remove the window from the frame. The window shall be reinstalled without the use of tools only after the shut-off handles have been returned to the open position.
8. The valve shall be 3 piece, ball-type design with brass forging body and chrome plated brass ball for sizes 1-2" to 2". Seats shall be reinforced Teflon with Viton seats.
9. Pipe stub extensions shall have dual gauge ports. One 1/8" NPT elbow shall be provided per valve. Pipe stubs extensions shall be supplied with suitable plugs or caps to prevent contamination of the assembly prior to installation.

G. MANIFOLDS

1. Manifolds shall meet NFPA 99 requirements.
2. Input power to the area alarm shall be 115-220 V, 50-60 Hz.
3. Manifolds shall be fully automatic type and shall switch from "Bank in Use" to "Reserve Bank" without fluctuation in the final line pressure. Upon switchover, the "Bank in Use" tank shall become the "Reserve Bank".
4. The control panel shall include a line gauge, two bank gauges and incorporates six LED's: two green for "Bank In Use," two yellow for "Bank Ready" and two red for "Bank Empty" on the front of the cabinet.
5. The manifold shall be capable of providing a local visual signal and shall activate an indicator at all master alarm panels upon bank switchover.
6. The manifold consists of two bank regulators (dome bias) used to reduce the cylinder pressure to the two-line regulators which in turn controls the final line pressure.
7. The manifold shall consist of an intermediate and line relief valve that is internally connected to a common vent port, terminating into a 1/2" (13 mm) FNPT pipe.
8. The manifold shall be equipped with a 3/4" (19 mm) outlet shutoff valve. The valve shall come complete with a 3/4" (19 mm) type "K" 6-3/4" (172 mm) long pipe extensions and 1/8" (3 mm) port for an optional pressure switch.
9. The header bars shall be equipped with high pressure shutoff valves outside the cabinet to allow for emergency isolation of the header bars. The header bar shall incorporate integral check valves for each station.
10. The manifold is equipped with pressure transducers, which sends information to the main circuit board for operation of the fail-safe relay which transmits a remote signal to the master alarm or buzzer.
11. Nitrous oxide manifolds shall include optional heaters are available for Nitrous Oxide manifolds.

H. MEDICAL VACUUM SOURCE SYSTEM

1. Manufacturer:
 - a. Amico
 - b. Beacon Medaes
2. Medical Vacuum Pump Source System: Packaged assembly factory wired, factory piped, with components mounted on common base and single point connections for electrical, intake air, discharge air, and condensate drains.
 - a. Isolate components with valves to allow service to each component without interrupting vacuum system operation.
3. System Components
 - a. Vacuum Pump: Stack mounted triplex (with capability of expansion to Quadplex without significant changes to skid assembly), Contactless Claw. Furnish each vacuum pump sized to achieve scheduled peak demand with NFPA system reserve pump on standby.
 - b. Control panel.
 - c. Discharge muffler.
 - d. Receiver.
 - e. Bacterial filter(s)
 - f. Source valve.
 - g. Vacuum indicator.
 - h. System vacuum switch and sensor.
 - i. Flexible intake connector.
 - j. Flexible discharge connector.
 - k. Flexible water connector.
4. Control Panel: UL listed electrical control system mounted in NEMA 250 Type 12 enclosure. Lag vacuum pump is able to start automatically when lead vacuum pump fails to operate. Including the following:
 - a. Magnetic motor starter for each vacuum pump.
 - b. Automatic lead vacuum pump alternator.

- c. Hand-Off-Auto selector switches.
 - d. Dual redundant control circuit transformers.
 - e. Externally operable fusible disconnect with door interlock.
 - f. Run time hour meter for each vacuum pump.
 - g. Motor running light.
 - h. Minimum run timer to prevent short cycle operation.
 - i. Control Panel Display: Furnish audible and visual local alarm complete with indicating lights and individual sets of auxiliary contacts wired to the terminal strip for remote alarm indication for the following:
 - 1) Vacuum pump thermal malfunction.
 - 2) Reserve vacuum pump in use.
5. Performance as scheduled on contract documents.

I. System Components:

1. Air Compressor: Duplex Scroll Air plant with desiccant air treatment system. Furnish each compressor with an after cooler with approach temperature of not greater than 12 degrees F (-11 degrees C).
2. Control panel.
3. Air intake filter.
4. Receiver:
5. Desiccant Air Dryer: Furnish two dryers piped in bypass arrangement each sized for rated system capacity. Capable of producing -40 degrees F pressure dew point.
6. Pressure Regulating Valve: Furnish pressure regulating valves piped in bypass arrangement each sized to pass rated system capacity.
7. Compressed Air Filter: Furnish two 0.01 micron pre-filters and two 1 micron after filters piped in bypass arrangement each sized to pass rated system capacity.
8. Dew Point Monitor. Furnish with demand check valve.

9. Source Valve.
 10. Relief valve.
 11. Pressure gage with demand check valve.
 12. System pressure switch or sensor with demand check valve.
 13. Flexible intake connector.
 14. Flexible discharge connector.
- J. Control Panel: UL listed electrical control system mounted in NEMA 250 Type 12 enclosure. Lag compressor is able to start automatically when lead vacuum pump fails to operate. Including the following:
1. Magnetic motor starter for each compressor.
 2. Automatic lead compressor alternator.
 3. Hand-Off-Auto selector switches.
 4. Dual redundant control circuit transformers.
 5. Externally operable fusible disconnect with door interlock.
 6. Run time hour meter for each compressor.
 7. Compressor running light.
 8. Minimum run timer to prevent short cycle operation.
 9. Panel mounted pressure gauge.
 10. Dryers controlled from main control panel with selector switches mounted on control panel.

2.8 UNDERGROUND PIPE MARKERS

- A. Furnish materials in accordance with State of North Carolina standards.

- B. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.
- C. Trace Wire (non-metallic piping): Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Medical Gas Service" in large letters.

2.9 LABELING AND IDENTIFICATION

A. Pipe Labels:

- 1. Furnish pipe labels or stenciling identifying the medical gas or vacuum system. Furnish with name of gas or vacuum system or chemical symbol.
- 2. Furnish pipe labels with colors in accordance with NFPA 99.
- 3. When gas system operates at other than standard pressures, include operating pressure in addition to gas name.

B. Valve Labels:

- 1. Label source valve, main line valve, riser valve, and service valve in accordance with NFPA 99.
- 2. Furnish valve with name of gas or vacuum system or chemical symbol. Label with room or area served. Label with caution to not open or close valve in an emergency.
- 3. When gas system operates at other than standard pressures, label valve with operating pressure in addition to gas name.

Cylinders: Label cylinder contents in accordance with CGA C-7.

C. Alarm Panels:

- 1. Label indicating condition monitored.
- 2. Label each panel for area of surveillance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify connection to existing piping system size, location, and invert is as indicated on Drawings.

3.2 PREPARATION

- A. Cleaning of Piping: If factory-cleaned and -capped laboratory nitrogen, air, and vacuum piping is not available or if precleaned piping must be recleaned because of exposure, perform the following procedures:
 - 1. Clean laboratory nitrogen, air, and vacuum tubes and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."
 - 2. Wash laboratory nitrogen, air, and vacuum piping and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
 - a. Scrub to ensure complete cleaning.
 - b. Rinse with clean, hot water to remove cleaning solution.
- B. Ream pipe and tube ends. Remove burrs.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment with flanges or unions.
 - 1. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Support horizontal piping in accordance with NFPA 99 and as scheduled in this section.
- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- E. Support vertical piping at every floor; maximum 15 feet on center. Support riser piping independently of connected horizontal piping.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.4 INSTALLATION - ABOVE GROUND PIPING - MEDICAL GAS SYSTEMS

- A. During brazing of pipe connections, purge interior of pipe continuously with nitrogen.
- B. Cut pipe and tubing accurately and install without springing or forcing.
- C. Slope piping in direction of flow.

- D. Make branch connections in accordance with NFPA 99.
- E. Pressure Gages:
 - 1. Install at locations identified in NFPA 99.
 - 2. Install capable of being read from standing position.
 - 3. Install pressure gages located downstream from source valve with demand check fitting.
- F. Install pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions. Refer to Section 220529.
- G. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 220529.
- H. Install pipe identification in accordance with this Section.
- I. Except where indicated or in flush wall mounted cabinets, install manual shut off valves with stem vertical and accessible for operation and maintenance.
- J. Install locks on valves.

3.5 INSTALLATION - EQUIPMENT

- A. Install medical gas system equipment in accordance with NFPA 99.
- B. Install valves and piping specialties as indicated on Drawings.

3.6 LABELING AND IDENTIFICATION

- A. Piping:
 - 1. Install pipe labels at intervals of not more than 20 feet.
 - 2. Install minimum of one pipe label in each room.
 - 3. Install label on each side of wall when penetrated by piping.
 - 4. Risers: Install minimum of one label for each story traversed by piping.

3.7 FIELD QUALITY CONTROL

A. Installer Performed Tests - Level 1 Systems:

1. Complete installer performed tests for each system in accordance with procedures specified in NFPA 99.

B. System Verification Tests - Level 1 Systems:

1. Perform after completion of Installer Performed Tests.
2. Conduct test by agency independent of system installer.
3. Complete system verification tests for each system in accordance with procedures specified in NFPA 99.

3.8 DEMONSTRATION

- A. Demonstrate each medical gas system and equipment operation and maintenance.

3.9 SCHEDULES

- A. Contractor to furnish valve scheduled to Owner indicated valve service area and location.

B. Pipe Hanger Spacing:

PIPE HANGER SPACING		
PIPE SIZE Inches (mm)	MAXIMUM HANGER SPACING Feet (m)	HANGER ROD DIAMETER Inches (mm)
1/4 (8)	5 (1.5)	3/8 (9)
3/8 (10)	6 (1.8)	3/8 (9)
1/2 (12)	6 (1.8)	3/8 (9)
3/4 (20)	7 (2.1)	3/8 (9)
1 (25)	8 (2.4)	3/8 (9)
1-1/4 (32)	9 (2.7)	3/8 (9)
1-1/2 (38) and Larger	10 (3)	3/8 (9)

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SECTION 230100 – MECHANICAL GENERAL

PART 1 GENERAL REQUIREMENTS

1.1 DEFINITIONS

- A. Piping: Pipe, fittings, flanges, valves, controls, hangers, supports, traps, drains, gauges, insulation, vents and items customarily required in connection with the transfer of fluids.
- B. Ductwork: All air distribution, re-circulation and exhaust ducts, whether of sheet metal or other material, and includes all connections, hanger, supports, damper controls, insulation, accessories, fire and smoke control devices, and appurtenances necessary for and incidental to a complete system.
- C. Provide: Furnish and install complete ready for use.
- D. Furnish: Purchase and deliver to the project site complete with every necessary appurtenance and for installation.
- E. Install: Unload at the delivery point and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.
- F. Concealed: Embedded in masonry or other construction, installed behind wall furring, above ceilings, in crawl spaces, in shafts or otherwise not visible.
- G. Exposed: Not concealed.
- H. By other Trades: Shall mean by persons or parties who are not anticipated to be the Subcontractor for this trade working together with the Prime Contractor. In this context the words “by other trades” shall be interpreted to mean not included in the overall contract.
- I. Contractor: As used in this Division of the specification refers to the Mechanical Contractor unless specifically noted otherwise.

1.2 INTERPRETATION OF CONTRACT DOCUMENTS

- A. This section of the specifications and related drawings describe general provisions applicable to every section of Division 23.
- B. Attention is directed to, General Conditions, which are binding in their entirety on this portion of the work and in particular to paragraphs concerning materials, workmanship and substitutions.
- C. Mention in these specifications, indications and reasonable implications on drawings, whereby articles, materials, operation or methods related to execution of the mechanical work are noted, specified, drawing or described, thereby requires execution of each such item of work and provision of all labor, materials, equipment and appurtenances required for execution thereof.
- D. Particular attention is directed to the drawings and other contract documents for information pertaining to required items or work which are related to and usually associated with the work of this Division of the specifications, but which are to be provided as part of the work of other Divisions of the specifications.

- E. No exclusions from, or limitations in, the language used in the drawings or specifications shall be interpreted as meaning that the appurtenance or accessories necessary to complete any required system or item of equipment are to be omitted.
- F. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the intent diagrammatically expressed on the drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded. When abbreviations appear on the drawings or specification in lower case letter with or without periods, their meanings shall be the same as stated above.
- G. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work.
- H. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.
- I. The use of words in the singular shall be considered as limited where other indications denote that more than one item is referred to.
- J. Submission of a proposal and ultimate acceptance of an agreement or contract for execution of this section of work will be construed as evidence that the Prime Contractor, Subcontractor and Vendor has carefully read and accepts all conditions set forth in each division. Insofar as such conditions may affect both the bidding for and execution of this section of work.
- K. Where compliance with drawings or specifications is in apparent conflict with the applicable building codes or applicable UL listings then contractor shall contact the engineer of record. Generally building codes and UL compliance will take precedence over the specifications and drawings.

1.3 QUALITY ASSURANCE AND WARRANTY

- A. The Contractor shall guarantee all work, materials and equipment furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of the Owner's final acceptance, or as indicated in the General Conditions. Warranties to extend past this date are defined in individual equipment specification sections. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.
- B. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service. Where no specific indication as to the type or quality of material or equipment is indicated, a first-class standard article shall be furnished. All manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacturers of said equipment a minimum of three (3) years and, if so directed

by the Designer, be able to furnish proof of their ability to deliver this equipment by submitting affidavits supporting their claim.

- C. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent will not be acceptable. UL or other label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
- D. All equipment of one type (such as fans, pumps, valves, grilles, etc.) shall be the products of one manufacturer unless specifically stated otherwise.
- E. Where the specifications do not list a specific model number for a manufacturer, the construction of a product shall be equal to those models specifically listed.
- F. All welders shall be certified by the National Certified Pipe Welding Bureau for the appropriate service, and shall perform all welding in accordance with Welding Bureau's procedures and the ASA Code for pipe welding. Welding and welder qualifications shall be in accordance with ASME Section IX.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- A. Contractors shall submit to the appropriate Regulatory Agencies all items necessary to obtain all required permits obtain such required permits and pay all required fees.
- B. All work shall conform to the following Standards and Codes (applicable edition):
 - 1. North Carolina State Building Code.
 - 2. National Fire Protection Association.
 - 3. Uniform Boiler and Pressure Vessel Act of N.C. (Boiler Code)
- C. Where applicable, all fixtures, equipment, and materials shall be as approved or listed by the following:
 - 1. Factory Mutual Laboratories (FM).
 - 2. Underwriters Laboratories, Inc. (UL).
 - 3. CSA
 - 4. ETL
 - 5. AGA
 - 6. AWWA
- D. All fuel fired equipment shall meet the requirements of the agencies listed and also meet the Owner's insurer requirements.

1.5 STANDARDS AND PROCEDURES:

1. ADC: Air Diffusion Council.
 2. AMCA: Air Moving and Conditioning Association, Inc.
 3. ANSI: American National Standards Institute.
 4. API: American Petroleum Institute.
 5. ARI: American Refrigeration Institute.
 6. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers.
 7. ASME: American Society of Mechanical Engineers.
 8. ASTM: American Society of Testing and Materials.
 9. IBR: Institute of Boiler and Radiator Manufacturers.
 10. MSS: Manufacturers Standardization Society.
 11. NEMA: National Electrical Manufacturer's Association.
 12. OSHA: Occupational Safety and Health Administration.
 13. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
- B. Where reference is made to ASA Standards it shall be understood that this reference is to the standards published by ANSI.
- C. Include all items of labor and materials required to comply with such standards and codes. Where quantity, sizes or other requirements indicated on the drawings or herein specified are in excess of the standard or code requirements, the specifications or drawings, respectively, shall govern.

1.6 EQUIVALENT PRODUCTS:

- A. Notwithstanding any reference in the specifications to any article, device, product, materials, fixture, form or type of construction by name, make, or catalog number, such references shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition and the Contractor, in such cases may, at his option, use any article, device, product, material, fixture, form or type of construction which, in the judgment of the Designer, expressed in writing, is equal to that specified.
- B. Requests for written approval to substitute materials or equipment considered by the contractor as equal to those specified shall be submitted for approval, to the Engineer, in accordance with SUBSTITUTIONS section.

1.7 VERIFICATION OF DIMENSIONS AND LOCATIONS:

- A. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work, working conditions, verify all dimensions in the field, advise the Designer of any discrepancy, and submit shop drawings of any changes he proposes to make, in quadruplicate for approval, before starting the work. Contractor shall install all equipment in a manner to avoid building interference.
- B. The location of duct, pipe, fixture, equipment and appurtenances for existing facilities are shown on plans to indicate the extent of work required. Exact condition shall be field verified.

1.8 COORDINATION WITH OTHER TRADES:

- A. Coordinate all work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings, and shall make sure that proposed equipment can be accommodated. If interferences occur and clearances cannot be maintained as recommended by manufacturer and as required for maintenance and inspection of equipment, Contractor shall bring them to the attention of Designer, in writing, prior to signing of contract; or, Contractor shall, at his own expense, provide proper materials, equipment, and labor to correct any damage due to defects in his work caused by such interferences.
- B. Prepare composite coordination drawings at a scale of $\frac{1}{4}'' = 1'-0''$ or larger, detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components (For all floor levels including all mechanical areas, penthouses, and roof plans. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work. The Mechanical Contractor will administer the effort of coordination between various trades. The coordination drawings will be prepared and reviewed approved by Engineer of Record and CxA before installation of any plumbing, sprinkler, mechanical or electrical work and will be shown as a task on the Project Schedule to be prepared by the General Contractor.

1.9 WORKMANSHIP

- A. Workmen to be thoroughly experienced and fully capable of installing assigned work. Work to be in accordance with the best standard practice of the trade. Work that is not of good quality will require removal and reinstallation at no additional expense to Owner and as approved.
- B. All material and equipment to be installed in accordance with manufacturer's printed recommendations (using recommended accessories) and/or as approved by the Designer. Retain a copy on job site and submit others for approval when required.

PART 2 PRODUCTS

This Part Not Used

PART 3 EXECUTION

3.1 SURFACE CONDITIONS:

- A. Inspection:

1. Prior to any work, the Contractor shall carefully inspect the installed Work of all other Trades and verify that all such Work is complete to the point where his installation may properly commence.
2. Verify that all equipment may be installed in accordance with all pertinent codes and regulations, the original design and the referenced standards.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Designer.
2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

3.2 INSTALLATION

- A. Install all equipment and appurtenances in strict accordance with the manufacturer's recommendations.

3.3 REQUIREMENTS FOR OPERATING HVAC EQUIPMENT DURING CONSTRUCTION

- A. Building must be fully enclosed, including installation of all doors, windows, etc.
- B. Set air handler to use 100% outside if construction is still generating dust and when conditions will not allow the coil to freeze.
- C. If return air is to be used then all exhaust and return ducts/grilles shall be covered with temporary filter media, minimum MERV 8, to prevent dust infiltration into the ducting.
- D. All chilled water piping shall be insulated.
- E. Pump and fans shafts shall be aligned prior to operation. Laser alignment shall be provided for pumps, and reports shall be furnished prior to operation.
- F. Supply and outside air connections of ductwork to AHUs shall be complete.
- G. All manual dampers, fire dampers and combination fire/smoke dampers shall be open.
- H. All main supply ductwork shall be insulated.
- I. All safety circuits and basic control functions shall be active and fully functional. If the equipment may operate without a fully functional BAS, then means to prevent damage to ducting due to closed dampers and means to prevent damage to freezing coils shall be provided. Blow-out doors may be used to protect ducting. Until TAB activities commence, fans and pumps shall operate at no more than 70% of estimated design capacity.
- J. Conditioning (cooling & dehumidifying) of the building shall remain once started.
- K. Final approval of Engineer and Owner are required prior to starting AHUs for temporary operation.

- L. Cover outside air intakes with 1" roll filter media.
- M. The contractor shall perform all required preventative maintenance on mechanical equipment operated during construction and provide documentation in the operation and maintenance manuals of preventative maintenance activities completed during this period.
- N. At the end of the construction period and prior to occupancy, clean the inside of AHUs and if more than 50% loaded, then install new pre and final filters.

3.4 PROTECTION AND CLEANING OF SYSTEMS AND EQUIPMENT

- A. Protect all materials and equipment from damage during storage at the Site and throughout the construction period. In the event of damage prior to final inspections, the Contractor shall repair or replace damaged items as determined by the Architect/Engineer, at no cost to the Owner.
- B. Damage from rain, dirt, sun, and ground water shall be prevented by storing the equipment on elevated supports and covering them on all sides with securely fastened protective rigid or flexible waterproof coverings.
- C. Piping shall be protected by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation in the piping.
- D. During construction cap the top of all ductwork and piping installed vertically.
- E. Periodically during construction and prior to Owner acceptance of the building, Contractor shall remove from the premises and dispose of all packing material and debris. All adjacent occupied areas shall be cleaned daily to remove dirt and debris resulting from this work.

3.5 SUBSTITUTION OF EQUIPMENT

- A. Requests for substitutions of products may be made during the bidding period by submitting completed substitution request accompanied by information sufficient for the Engineer to make a determination as to the equivalency of a product.
- B. The Engineer will consider requests utilizing this section for substitution of products in place of those specified.
- C. Submit 14 calendar days prior to Bid Date. No substitutions will be reviewed or accepted after this date unless there is an obvious advantage to the Owner.
- D. Substitution requests may be submitted by U.S. Postal Service.
- E. Prime Bidders shall request a substitution on the letterhead stationary of the Prime Bidder submitting the request. Requests from individual manufacturers will not be accepted.
- F. Submit separate request for each substitution. Support each request with the following information. All items must be addressed.
- G. Complete data substantiating compliance of proposed substitutions with requirements stated in Contract Documents:

1. Product identification, including manufacturer's name and address.
2. Manufacturer's literature, identifying:
 - a) Product description.
 - b) Reference standards.
 - c) Performance and test data.
3. Name and address of similar projects on which product has been used and date of each installation.
4. Itemized comparison of the proposed substitution with product specified, listing significant variations.
5. Data relating to changes in construction schedule, if any.
6. All effects of substitution on separate contracts.
7. List of changes required in other work or products.
8. Designation of availability of maintenance services and sources of replacement parts.

H. Substitutions will not be considered for acceptance when:

1. Acceptance will require substantial revision of Contract Documents.
2. In judgment of Engineer, substitution request does not include adequate information for a complete evaluation.
3. Requests for substitutions not submitted by a Prime Bidder.
4. Where the effect on the schedule will be negative.

I. In making formal request for substitution, the Prime Bidder represents that:

1. The Prime Bidder has investigated proposed product and has determined that it is equivalent to or superior in all respects to that specified.
2. The Prime Bidder will provide the same warranties or bonds for substitution as for product specified.
3. The Prime Bidder will coordinate installation of accepted substitution into the Work and will make such changes as may be required for the Work to be complete in all respects.

3.6 SUBMITTALS

- A. Refer to Division 1, as available, for information on submittal requirements. When conflicts exist, Division 1 shall apply.

- B. The terms “Submittals” can generally be used to indicate any information which is required to be reviewed by the A/E before further action on that product can be taken by the Contractor. This may include product data sheets, shop drawings, and schedules.
- C. Submittals generally not required when equipment is purchased exactly as specified and scheduled. Submit list of such equipment only. Equipment data sheets must be included in project manual prepared for Owner.
- D. Submittals shall be searchable format, preferably pdf.
- E. PRODUCT SUBMITTALS

1. The following product data information shall be submitted:

Product	Submitted	Approved
Split Systems	_____	_____
Air Filters	_____	_____
Air Handling Units	_____	_____
Air Distribution Devices	_____	_____
Balancing Fittings	_____	_____
Controls	_____	_____
Dampers	_____	_____
Duct Access Doors	_____	_____
Duct Sealants	_____	_____
Fans	_____	_____
Fire and Smoke Damper	_____	_____
Fire Stop Material	_____	_____
Insulation, Mastics and Sealants	_____	_____
Sheet Metal Specialties	_____	_____
Temperature Controls/BAS	_____	_____
Terminal Heat Transfer Units	_____	_____
Valves and Strainers	_____	_____
Variable Frequency Drives	_____	_____

Vibration Isolators/Seismic Restraints _____

F. TEST AND REPORT SUBMITTALS:

The following list may be used as a checklist for the contractor and A/E. All tests may not be listed.

1. TEST

- a) Underground and Aboveground HVAC piping
- b) Duct pressure Test
- c) System start-up
- d) Test and Balance Agency Construction report.
- e) All required Test Reports.
- f) Boiler Inspection
- g) Gas piping pressure test
- h) Required Pressurization Systems

G. FIRE PENETRATION SYSTEMS SUBMITTAL:

1. Each type system penetrating a fire rated assembly shall be identified by the Contractor. The Contractor shall demonstrate his understanding of fire stop systems by the following:
2. Submit 3/4 inch scale drawings of each assembly indicating type penetrations, slab, floor, wall or roof system, fire stop materials used, thickness and all other pertinent details. Submittal shall be neatly and accurately drafted.
3. Each type system penetrating a fire rated assembly shall be identified by the Contractor. Provide approved installation details with agency approval indicated thereon.

3.7 RECORD DRAWINGS:

- A. The Contractor shall keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of all items, material and equipment of these job drawings.
- B. At the time of final inspection, two corrected sets of prints and sepias shall be delivered to the Designer. All drawing costs to be paid by the Contractor.
- C. Qualified draftsmen shall perform this task.

3.8 OPERATION AND MAINTENANCE MANUALS:

- A. The Contractor shall compile and bind three (3) sets of all manufacturer's instructions and descriptive literature on all items of equipment furnished under this work. An electronic PDF copy of the O&M manuals shall also be provided and shall have searchable text.
- B. The manuals shall comply with specifications in this section in addition to specifications in other mechanical specifications as well.
- C. Binder shall be hard cover, three-ring notebook, 11" x 8-1/2" with heavy duty rings. Maximum binder size shall be 2-1/2".
- D. The front of the binder shall be titled "Mechanical Operating and Maintenance Instructions," with the name of the job and documents date under the title.
- E. Operating and Maintenance Instructions shall include the following:
 - 1. A sheet in each binder listing the architect, engineer, and all contractors. List addresses and phone numbers.
 - 2. List name, address and phone number of organization responsible for warranty work if other than contractor and the specific work for which he is responsible.
 - 3. List name, address and phone number of the nearest sales and the nearest service organization for each product.
 - 4. Schedules of all equipment indicating identification number shown on plans cross referenced to field applied identification tag number.
 - 5. Performance Curves: For pumps, balance valves and similar equipment at the operating conditions.
 - 6. Lubrication Schedule: Indicating type and frequency of lubrication required.
 - 7. List of Spare Parts: Recommended for normal service requirements. Each piece of equipment shall have this list clearly marked or attached to this submittal.
 - 8. Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
 - 9. Instruction Books: May be standard booklets but shall be clearly marked to indicate applicable equipment and characteristics.
 - 10. Wiring Diagrams: Generalized diagrams are not acceptable, submittal shall be specifically prepared for this Project.
 - 11. Automatic Controls: Diagrams and functional descriptions.
 - 12. Test and Balance Reports.
 - 13. Valve tag list: Identifying valve type, size, service and general location.
 - 14. Filter schedule: Identifying filter type, size efficiency, manufacturer and equipment number.

15. Ceiling marker schedule.

F. The following diagrams, schematics and lists shall be framed under glass and hung adjacent to equipment, in mechanical rooms, or where directed by Owner.

1. Automatic control diagrams.
2. Sequence of operation.
3. Valve Tag List

3.9 OPERATIONAL AND MAINTENANCE INSTRUCTION:

A. After all final tests and adjustments have been complete, a competent employee of the Contractor shall be provided to instruct the Owner's Representative in all details of operation and maintenance for equipment installed. Supply qualified personnel to operate equipment for sufficient length of time after instructions to assure that Owner's Representative is qualified to take over operation and maintenance procedures. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive. Minimum instruction periods shall be as follows:

1. Air handling units, Chilled Water, Hot Water, and Steam Systems (1 working day)
2. Air distribution system and Exhaust Systems (1/2 working day)
3. Split Systems (1/2 working day)

B. Instruction period shall be performed during the forty-five (45) days following substantial completion at time periods as approved by Owner.

3.10 CONTROLS OPERATION AND MAINTENANCE INSTRUCTION:

A. Upon completion of Operation and Maintenance instructions, competent employees of the Control Contractor shall be provided to instruct the Owner's representative in all details of operation and maintenance for the controls installed. Supply qualified personnel to operate system for sufficient length of time after instructions to assure the Owner's Representative is qualified to take over operation and maintenance procedures.

B. Controls Operation and Maintenance Instruction shall include the entire control system including control sequences that are inherent to equipment provided by the Equipment Manufacturer including economizer cycles, burner operation, low ambient operation, freezstats and similar sequences. Contractor shall provide sufficient personnel equipment walkie-talkies, gauges, and other accessories for this work.

C. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive. Minimum instruction periods shall be one (1) working day for on-site training.

D. Instructional period shall be performed during the forty-five (45) days following substantial completion at time periods as approved by Owner. One (1) day of instructions shall be in a formal classroom setting as determined by the owner.

- E. Classroom instructions shall be video taped by the Contractor. A copy of each tape shall be provided to the Owner. Contractor shall be responsible for all equipment, tapes, and accessories required.

3.11 GENERAL COMPLETION AND DEMONSTRATION:

A. RESULTS EXPECTED:

1. All systems and controls shall be complete, tested and operational.
2. All start-up and testing and balancing shall be complete.
3. All equipment shall be thoroughly cleaned. All excess materials and all debris shall be removed from the site.
4. All walls, floors, ceilings and other surfaces marred or otherwise damaged as a result of execution of this contract shall be cleaned and repaired to the satisfaction of the Designer and Owner.

END OF SECTION

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SECTION 230200 – MECHANICAL RELATED WORK

PART 1 GENERAL REQUIREMENTS

1.1 DRAWINGS AND SPECIFICATIONS

- A. Provide all materials called for in these specifications and accompanying drawings and provide the apparatus complete in every respect. Anything called for in the specifications and not shown on the drawings, or shown on the drawings and not called for in the specifications must be provided.
- B. Where there is a discrepancy between drawings and specifications, the worst case shall be assumed.
- C. Drawings show arrangements of system desired and shall be followed as closely as practical. Because of the small scale of the drawings not all offsets and bends can be shown and these shall be provided as required, to fully complete the intent of plans. Should conditions and substitutions of equipment necessitate a rearrangement, prepare and submit for review scaled drawings of such rearrangement, before beginning work.
- D. Verify and check all measurements in the field.
- E. Review architectural, structural, and electrical plans, and cooperate and coordinate work with other trades to the extent that interference shall be avoided. Discrepancies shown on different plans, or between plans and specifications, shall promptly be brought to the attention of the Designer.

1.2 CONCEALMENT OF PIPE AND DUCTS

- A. Chases and Holes: Unless otherwise indicated, all piping and ductwork shall be run in concealed spaces between floor and ceilings or in chases. Ductwork and piping areas without ceilings shall be installed, exposed and as high as practical. This Contractor shall be responsible for the location and size of holes required for pipe, ducts and other equipment and shall advise of chase spaces and holes required as building progresses. Failure to do so shall require this Contractor to provide or cut same.

1.3 CUTTING & PATCHING

- A. This Contractor must have an experienced Mechanic upon the job before concrete floors, concrete or masonry walls are set in place, whose duty it shall be to locate the exact position of any and all sleeves and holes for the future installation of his pipe or duct work. This Contractor shall locate and size all openings required for his equipment in time to not delay the building construction.
- B. If it becomes necessary to cut holes in concrete floors or concrete or other masonry walls, this Contractor shall call the General Contractor or his superintendent of Construction, and inform him of the position and size of the hole or other opening to be provided and the General Contractor shall determine how this will be done. Under no condition shall this Contractor make any cuts without permission from the General Contractor.
- C. This Contractor shall arrange proper openings in the building to admit his equipment. If it becomes necessary to cut any portion of the building to admit any equipment or install

mechanical systems, this Contractor shall be responsible for cutting and patching. The portions cut must be restored to their former condition by this Contractor.

- D. All cutting of structure shall be done using best method to minimize noise and cracking of structure. The method of cutting shall be approved by the Project Expediter (Prime Contractor) before work is started.
- E. All drilled holes required for equipment or supports shall be done by this Contractor. Holes for piping shall be core drilled only.

1.4 EQUIPMENT STANDS, FOUNDATIONS AND MISCELLANEOUS STEEL FOR HANGERS AND SUPPORTS

- A. Provide all equipment stands and supports for equipment as shown or required. Provide miscellaneous steel for hanging piping, ducts or other items of equipment as shown as required.
- B. All concrete foundations, curbs and pads for equipment, ductwork, piping, etc. shall be provided by this Contractor, unless otherwise indicated. Pads shall be provided for all floor standing equipment.
- C. All stands shall be adequately cross-braced to provide rigid supporting foundation. All stands shall be adequately anchored to wall or floor as required. All miscellaneous steel shall have one coat of shop paint and two finished coats of rust resistant paint.

1.5 SITE EXAMINATION

- A. Contractor, prior to submitting a bid, shall visit the site and thoroughly acquaint himself with the conditions under which the work will be performed.

1.6 PAINTING

A. WORK TO BE PAINTED:

1. All piping, ductwork, conduit, steel supports, hangers, and other mechanical items exposed to view in occupied areas shall be painted under Division 09 by General Contractor.
2. All insulated piping as noted in Section 230700, uninsulated piping, ductwork, supporting steel and hangers for piping, ductwork and equipment (except made of galvanized steel) shall be shop coated with rust proof primer and shall be field painted by Mechanical Contractor except where installed above ceilings or where concealed in building construction. Concealed supports and hangers do not require painting.
3. All exposed insulated and uninsulated piping and ductwork in Mechanical Room shall be painted by Mechanical Contractor with (2) coats of paint.
4. All areas where cutting and patching are required the mechanical contractor shall paint to match adjacent surfaces.

B. WORK NOT REQUIRING PAINTING:

1. Piping and ductwork above solid (lay-in, gypsum board, etc.) ceilings do not require painting.

2. All exposed items specified to be finished by manufacturer will not be painted. See "Manufacturers' Finished Products".

C. MANUFACTURERS' FINISHED PRODUCTS:

1. All manufacturer finished products, such as water pumps, fans, air handling units, control panels, etc., shall have factory standard finish except where otherwise specified on the drawings or in other sections of this specification.
2. Contractor providing finished products shall be required to touch up any minor damages or scratches due to shipment, installation or exposure to weather on all equipment with baked enamel or equivalent finish, Prime coated equipment shall be cleaned and touched up. Large areas of damaged finish shall be painted to match factory painting.

PART 2 PRODUCTS

2.1 ROOF CURBS AND EQUIPMENT SUPPORTS

- A. See notes on plans for supports provided by others.
- B. Manufactured Equipment: Furnish all rooftop type manufactured equipment with a prefabricated roof curb designed to support the equipment. The equipment base shall overhang the curb and act as a cap flashing. Where required, curb shall be designed for sloping roof.
- C. Curbs: Curbs shall be prefabricated metal roof curbs constructed using minimum 18 gage thick galvanized steel minimum 14 gage galvanized steel with any side longer than 48", with fully mitered and welded corners, integral base plate with minimum 3/4" exterior flange and unobstructing interior edge, 1 1/2" thick 3 lbs/sq. ft. density rigid interior fiber glass insulation and pressure treated wood nailers.
 1. Roof curbs shall have 45 degree cant.
 2. Minimum height of curbs shall be 12" above the finished roof.
 3. Roof curbs shall be constructed to match roof deck slope to create a level top surface.
 4. Roof curbs shall have an internal flange suitable for damper installation, where applicable.
 5. Roof curbs shall have an ABS thermoplastic cap with integral graduated step boots for pipe and round duct penetrations. Include adjustable stainless steel clamps, 2 per boot. Refer to drawings for pipe sizes and quantities.
- D. Equipment Supports: Supports shall be prefabricated metal curb supports constructed of minimum 1.9 mm (14 gage) thick galvanized steel with fully mitered and welded corners, integral base plate with minimum 3/4" flange, pressure treated top wood nailer, and 18 gage thick galvanized steel counterflashing cap.
 1. Supports shall be 45 degree cant.
 2. Minimum height shall be 12" above the finished roof.

3. Supports shall be constructed to match roof deck slope to create a level top surface.

PART 3 EXECUTION

3.1 FORMWORK

- A. General: Design, construct and maintain formwork to support vertical and lateral loads including pressure of cast-in-place concrete. Construct formwork so that formed concrete will be required size and shape and in required location. Construct with joints which will not leak cement paste. Form side and bottoms of concrete work, except where clearly indicated to be cast directly in excavation or against other construction, or on grade or prepared subgrade. Design and construct forms for easy removal without damage to concrete and other work.
- B. Form Costing: Cost concrete-contact surfaces of forms to be removed. Apply form-coating compound before reinforcement is placed. Apply in accordance with manufacturer's instructions and remove excess compound and spillage.
- C. Deposit concrete continuously or in layers of thickness which will result in no concrete being placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within section. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable in its final location, so as to avoid segregation due to rehandling or flowing.
- D. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures complying with recommended practices of ACI 309; eliminate voids in work.
- E. Bring horizontal surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps and hollows.
- F. Cold Weather Placement: Comply with ACI 306. Do not use frozen materials or materials containing ice and snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. When air temperature has fallen or is expected to fall below 40 degrees F, heat water and aggregates uniformly before mixing, as required to obtain concrete mixture temperature of not less than 50 degrees F, and not more than 80 degrees F, at time of placement. Protect concrete work from physical damage and reduced strength resulting from frost, freezing actions, or low temperatures.

END OF SECTION

SECTION 230300 – ELECTRICAL WORK FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. 120V and 24V control Wiring
- B. Electrical wiring.
- C. Starters and controllers

1.2 CODES, STANDARDS, QUALIFICATIONS

- A. All work shall conform to all sections of the most current North Carolina State Building Codes
- B. All work shall conform to all North Carolina Department of Administration State Construction Office Guidelines.
- C. Electrical equipment shall be listed and/or labeled by an independent testing agency approved by the State Building Code.
- D. Enclosure for electrical equipment and enclosed switches shall meet NEMA standards.

PART 2 PRODUCTS

2.1 WIRING

- A. All wiring and conduit shall be in accordance with the requirements of Division 26.
- B. Low voltage control wiring shall be not less than #18 gauge copper wire run in metallic conduit.
- C. Low voltage shall be defined as a circuit operating at less than 30 volts and meeting the requirements of NEC Section 720 for Class I, power limited circuits.

2.2 MOTORS

- A. Allowable manufacturers:
 - 1. Baldor Super-E EM/XE (general purpose family) with optional cast iron frame
 - 2. TECO/Westinghouse ASHH or Max-PE, WEG W22
 - 3. Toshiba
- B. Substitutions:
 - 1. Must be pre-approved in compliance with procedures outlined in 23 01 00 Mechanical General Specification.
- C. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with standards of ASA C50 and conform thereto for insulation

resistance and dielectric strength. Motors shall be provided with conduit terminal box, adequate starting and protective equipment as specified or required. Size shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and at least shall be the horsepower indicated or specified. Motors shall be selected for quiet operation.

- D. Motors less than 3/4 HP shall be single phase, PSC/capacitor start-induction run, open type, splashproof. Motors 3/4 HP and larger shall be induction, open 3-phase multi tap unless otherwise indicated. Voltage for 3-phase motors is noted in schedules. Coordinate electrical service requirements with Electrical Contractor.
- E. Motors shall be provided with overload protection. On 3-phase motors overload protection shall be in the starters. Single-phase motors shall have built-in thermal overload protection.
- F. Motors shall be sufficient size for the duty to be performed, not less than that indicated on the drawings, and shall not exceed their full rated load when the driven equipment is operating at specified capacity under the most severe conditions likely to be encountered. All motors shall be for continuous duty classification based on 40 degrees C ambient temperature unless otherwise indicated.
- G. Motors less than 1 HP shall have efficiencies that comply with the current N.C. Building Code. Efficiency shall be determined in accordance with IEEE Standard 112, method B.
- H. Motors 1 HP and larger shall have efficiencies that comply with NEMA Premium Efficiency ratings.
- I. All vertically mounted motors shall be provided with thrust bearings.
- J. Motors shall be open dripproof (ODP) for indoor use where satisfactorily housed, guarded dripproof when exposed to contact by employees or building occupants, TEFC (totally enclosed fan cooled) for outdoor use.
- K. Motors that are specified to cycle on and off automatically under control of a device shall be capable of making starts as frequently as the device may demand. Other motors shall be capable of being started 4 times per hour without damage.
- L. Motors that are to be used with adjustable frequency drives shall be approved by the motor manufacturer for that service.
- M. All 3-phase motors shall be provided with lugs.
- N. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque. Class "B" insulation shall be provided.
 - 1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
 - 2. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
 - 3. Service Factor: The service factor shall be at least 1.15 for polyphase motors and 1.35 for single phase motors.

4. Provide solid shaft grounding rings (Aegis SGR or approved equal). Soft carbon brushes and split shaft grounding rings shall not be accepted.
- O. All motors 40 hp and larger not provided with VFD shall be provided with reduced voltage starters.
- P. Provide armored AFD power cables for all motors served by AFD.
- Q. For frames 284 or larger, bearing shall be capable of lubrication. Extend grease lines to an accessible location. For frames 140T-280T, bearings shall be shall be capable of lubrication unless specifically reviewed and approved otherwise with Engineer and Owner.
- R. The opposite shaft end bearing shall be clamped to secure the bearing in the housing. Electrical characteristics and horsepower shall be as specified on the project schedule.
- S. For air handler fan motors, in a direct drive application, motors shall be capable of running continuously from 0 to 120Hz and deliver full rated horsepower at 60 to 120Hz operating frequencies. All motors shall maintain a minimum service factor of 1.15 throughout a 60 to 120HZ operating range. Motors shall conform to a G2.0 balance per NEMA S2.19.

2.3 STARTERS AND CONTROLLERS

- A. Controllers and Control: Where controllers and controls are specified to be provided by the Contractor, they shall conform to the requirements specified below:
 1. Controllers shall conform to adopted standards and recommended practices of the Industrial Control Standards of National Electrical Manufacturer's Association and the standard for Industrial Control Equipment of the Underwriters' Laboratories, Inc. Motors 93 W (1/8 hp) or larger and shall be provided with thermal overload protection. Manually reset type. Overload protective device shall be provided, mounted in separate enclosure. Two speed motors shall have 2 winding type controllers unless otherwise specified.
 2. Combination magnetic starter shall be full voltage, across the line type with under-voltage release for manual or automatic operation and shall break all phases on 3 phase starters for motors up to 40 hp. Starters shall be provided with start-stop pushbuttons mounted on cover unless controlled by hand-off-automatic (HOA) device. Hand-off-automatic device shall not be wired to override safety device interlocks on starter and shall be mounted on the starter or if adjacent mounted remotely, provide test start pushbutton on starter. All auxiliary contacts required for interlocking purposes shall be furnished and installed by the Contractor furnishing the starter. All starters not included in motor control centers shall be provided by Division 23.
 3. Manual starters shall be provided with a manually operated trip free switch, horsepower rated with a separate fused disconnect.
 4. Contractor providing the starters shall be responsible for all motors to be protected with proper size heater or thermal elements. All starters and enclosures shall be NEMA Standard, Type 1 unless otherwise specified. In wet locations, enclosures shall be NEMA 3R.

5. All starters and pushbutton stations shall be provided with labels as specified under identification designating service for which starter is used. Plate shall be firmly attached to starter or wall mounted adjacent to the starter.
6. All cabinets provided for the installation of motor starters, control transformers, relays, and appurtenant items shall be provided with gravity or forced ventilation at the option of the manufacturer. Openings shall be placed at bottom and top of the cabinet or high-low in the door if recessed and of sufficient size to limit the temperature rise through the enclosure or ambient compensated heater elements shall be provided.
7. All controllers and starters shall be rated for the same voltage as the motor which it serves. If the voltage is not indicated on the HVAC drawings, the Contractor shall provide the units at the voltage listed on the electrical drawings.
8. Provide interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.
9. Provide built-in 120 volts control circuit transformer, fused from line side, where service voltage exceeds 240 volts.
10. Provide externally operated manual reset.
11. Motor connections shall be in waterproofed sealtite flexible conduit, maximum length of 457 mm (18"), except where plug-in electrical cords are specifically indicated.

2.4 SAFETY SWITCHES

- A. All safety switches specified in Division 23 or on mechanical plans shall be heavy-duty type, NEMA 1 for indoor and NEMA 3R for outdoor use unless specifically stated specifically otherwise on plans. They shall be fused type unless specifically indicated otherwise on plans. Fused type shall be equipped with the following: Service Entrance and Feeder Circuits over 600A – Class L, UL Listed, current limiting with 200K interrupting rating; Service Entrance and Feeder Circuits 600A and less – Class RK1 or J, UL Listed, current limiting with 200K interrupting rating; Motor, Motor Controller and Transformer Circuits – Class RK5, UL Listed, current limiting time delay with 200K interrupting rating; and Individual Equipment where fault current does not exceed 50kA – Class K5, UL Listed, with 50K interrupting rating. Fusible safety switches with short circuit withstand rating of 100K or 200K shall include Class R or Class J rejection fuse block feature. Switches shall be equipped with defeatable door interlocks and padlocking provisions in the on and off positions. Padlocks shall be provided for switches located in public areas. Switches shall be by Square D, Cutler-Hammer, General Electric Co., or equivalent by others.
- B. Contractor shall furnish one spare set of fuses for each piece of equipment.
- C. All safety switches, motor starters, or other boxes or panels, designated as NEMA 3R or otherwise intended for outdoor use or use in wet areas, shall use raintight conduit hub fittings with bonding screw.
- D. Control wiring shall not be installed in the same raceways as power wiring.

PART 3 EXECUTION

3.1 WIRING

- A. Regardless of voltage, furnish and install all temperature control wiring, and all interlock wiring and equipment control wiring for the equipment furnished.
- B. Electrical Contractor will furnish and install all power wiring to load side of starters (see details on plans). The mechanical contractor shall furnish disconnects for equipment. Mechanical contractor shall provide all line side power wiring (see details on plans) and temperature control and interlock wiring. Controllers and controls shall be provided by the Mechanical Contractor.
- C. Check with Electrical Contractor on service outlets provided to determine that service, circuit protection, switches and wiring provided are of adequate size to meet Code requirements for equipment provided. Discrepancies shall be brought to the attention of the Designer before work is installed. Cost for changes not so noted shall be at the expense of this Contractor. Electrical cost increase due to equipment substitution of different electrical characteristics shall be this Contractor's expense.
- D. Provide necessary electrical data for all equipment to the Electrical Contractor for proper coordination.
- E. Control and interlock wiring shall be run in conduit. Conduit shall be minimum 3/4" in size.
- F. Provide control circuit disconnect for all motor starters as required by Section 430-74 of NEC.
- G. Unless otherwise noted or specified, all low voltage and line voltage control and instrumentation wiring and devices for equipment furnished under Division 23 shall be provided as part of this Division 23. Control wiring is considered to be the portion of the wiring which carries the electric signal directing or indicating the performance of a starter, relay, or contactor generally installed between starters, indicators, and remote control devices. All wiring from indicated or available electrical source in the electrical room and/or mechanical room to direct digital control panels shall be provided as part of this Division.
- H. Examine the drawings, and in cooperation with the Electrical Contractor, confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping to be no closer than 24" from the vertical line to electric motor controllers, switchboards, panelboards, or similar equipment. If the vertical line is less than 24", the installation of piping shall be relocated.

END OF SECTION

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SECTION 230500 – FIRESTOPPING AND WATERPROOFING

PART 1 GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

A. General

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the patching and repair of building structure, finishes and building assemblies as specified hereinafter.
2. Furnish all labor, materials, tools and equipment and perform all penetrations in connection with the installation of fire stopping and smoke stopping systems required to seal all penetrations of required rated partitions, walls or assemblies for Division 23 work.

B. Descriptions:

1. Patch and repair all building finishes, structural components, or other appurtenances that are removed or damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure and materials required for the installation of such work in accordance with standard practices.
2. All penetrations through exterior walls, floors, and roof systems shall be sealed watertight.
3. Firestop all existing openings in walls, roofs, slabs and similar assemblies remaining as a result of removing existing pipes, ducts, conduit, equipment appurtenances.
4. Firestop and Smokestop as required for assembly type all new openings in walls, roofs, slabs and similar assemblies at pipe, duct, conduits, equipment and appurtenances.
5. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

1.2 QUALITY ASSURANCE

A. Materials:

1. Materials shall be new, unused, properly stored and matching existing in colors, texture, finish, appearance and function.
2. Fire stopping and smoke stopping materials shall be delivered to the job site ready to install and require no critical mixing procedures or precise installation time constraints.
3. Materials shall be delivered to the site in sealed containers, fully identified with manufacturer's name, brand, type, grade and U.L. and FM labels. Store materials in a dry space under cover and off the ground.
4. Products shall be applied in strict accordance with their listing and manufacturers' application requirements.

B. Code and Standards: All work shall meet or exceed the standards and procedures (latest editions) of the following:

1. ASTM E814, Fire Tests of Through-Penetration Firestop Systems.
2. UL 1479, Through-Penetration Firestop Systems.

C. Manufacturer: The following firestopping and waterproofing sealant manufacturers are acceptable:

1. Nelson
2. Thomas & Betts
3. 3M
4. Hilti
5. GE
6. Frye Putty

D. The following smoke stopping manufacturers are acceptable:

1. Nelson
2. Thomas & Betts
3. 3M

PART 2 PRODUCTS

2.1 FIRESTOPPING:

A. Firestopping material shall maintain its dimension and integrity while preventing the passage of flame, smoke and gases under conditions of installation and use when exposed to the ASTM E119 time-temperature rating of the assembly penetrated.

B. All material shall be listed by U.L.

2.2 SMOKESTOPPING:

A. Smoke-stop shall provide an effective barrier against the spread of smoke.

B. All material shall be listed by U.L.

2.3 WATERPROOFING:

A. Sealant materials shall be as follows:

1. Penetrations of Fire Rated assemblies shall meet the requirements of 2.1 FIRESTOPPING specified hereinbefore.

2. Exterior joint sealant shall be Polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining; non-bleeding; colors selected by Architect/Engineer.

2.4 SUBMITTAL

- A. Provide U.L. approval assembly detail for specific application of the product.
- B. Provide installation detail of the product

PART 3 EXECUTION

3.1 GENERAL

- A. Exercise care in the performance of this contract so as not to damage any existing building components and finishes, outside components, shrubs, or other appurtenances.
- B. Clean and prepare joints for sealant application in accordance with manufacturer's recommendations. Ensure that joint forming materials are compatible with sealant.
- C. Openings larger than required for proper installation of pipe or duct shall be patched or repaired.
- D. Protect the roof at all times. Provide planking, plywood, supports, and other materials and means to ensure damage is not incurred.
- E. Firestopping and smoke stopping will meet the U.L. approved assembly detail for the product used.

3.2 EQUIPMENT PENETRATIONS:

- A. Seal all openings into equipment resulting from installation of equipment such as piping and conduit.
- B. Repair all insulation damaged during installation of equipment.

END OF SECTION

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SECTION 230529 – SUPPORT AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Placement of inserts sleeves in existing walls and slabs.
- B. Placement of roofing duct supports.
- C. Placement of equipment roof supports.
- D. Placement of roof sleeves, vents, and curbs.

1.3 REFERENCES

- A. ASME B31.1 - Power Piping
- B. ASME B31.2 - Fuel Gas Piping
- C. ASME B31.5 - Refrigeration Piping
- D. ASME B31.9 - Building Services Piping
- E. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- F. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- G. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- H. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- I. NFPA 13 - Installation of Sprinkler Systems.
- J. NFPA 14 - Installation of Standpipe and Hose Systems
- K. UL 203 - Pipe Hanger Equipment for Fire Protection Service

1.4 SUBMITTALS

- A. Submit under provisions of Division 1.

- B. Product Data: Provide manufacturers catalog data including load capacity.
- C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for support of hydronic piping.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Pipe hangers for insulated piping shall be sized to fit around the pipe covering. Contractor shall provide at each hanger a galvanized insulation protection shield formed to fit the outside of the covering. Shield shall extend above center line on both sides. Shield to be #18 gauge up to 3" pipe, #16 gauge up to 6" pipe and #14 gauge for 8" and larger. Provide rigid insulation under all hanger. See Section 230700, Insulation.
- B. Hydronic Piping:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe Sizes 1/2 to 1 1/2 Inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
 - 5. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
 - 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 - 8. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
 - 9. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - 10. Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
 - 11. Vertical Support: Steel riser clamp.
 - 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

13. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Metal Counterflashing: 22 gage galvanized steel.
- C. Lead Flashing:
 1. Waterproofing: 5 lb/sq ft (24.5 kg/sq m) sheet lead
 2. Soundproofing: 1 lb/sq ft (5 kg/sq m) sheet lead.
- D. Flexible Flashing: 47mil thick sheet compatible with roofing.
- E. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

2.4 EQUIPMENT CURBS

- A. Fabrication: Welded 18 gage (1.2 mm) galvanized steel shell and base, mitered 3 inch (75 mm) cant, variable step to match roof insulation, 1-1/2 inch thick insulation, factory installed wood nailer, sloping base to match sloping roof where required.

2.5 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage (1.2 mm thick) galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Galvanized steel.
- E. Sleeves for Rectangular Ductwork: Galvanized steel.

PART 3 EXECUTION

3.1 INSTALLATION

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

3.2 INSERTS

- A. Provide inserts for placement in concrete walls and slabs as noted on plans.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- C. Place hangers within 12 inches (300 mm) of each horizontal elbow.
- D. Use hangers with 1 1/2 inch (38 mm) minimum vertical adjustment.
- E. Support vertical piping at every floor.
- F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.
- H. Provide copper plated hangers and supports for copper piping.
- I. Design hangers for pipe movement without disengagement of supported pipe.
- J. Prime coat exposed steel hangers and supports. Refer to Division 9. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 6 inches thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Division 3.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches (75 mm) minimum above finished roof surface with lead worked one inch (25 mm) minimum into hub, 8 inches (200 mm) minimum clear on sides

with 24 x 24 inches (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.

- C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- D. Provide curbs for mechanical roof installations 8 inches minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints. Roof curbs shall be constructed to match the roof slope so the equipment will be installed level with the ground.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping material and caulk as per UL approved detail. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install chrome plated steel escutcheons at finished surfaces.

3.7 SCHEDULES

	Pipe Size Inches	Max Hanger Spacing Feet (m)	Hanger Rod Diameter Inches (mm)
1.	1/2 to 1-1/4	6.5 (2)	3/8 (9)
2.	1-1/2 to 2	10 (3)	3/8 (9)
3.	2-1/2 to 3	10 (3)	1/2 (13)
4.	4 to 6	10 (3)	5/8 (15)
5.	8 to 12	12 (3.7)	7/8 (22)

END OF SECTION

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SECTION 230548 – VIBRATION ISOLATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation as noted on plans for motor driven equipment over 3/4 HP, plus connected piping and ductwork. Provide neoprene pad isolator under each Air Handling Unit.
- B. Provide minimum static deflection of isolators for equipment as indicated.
 - 1. Basement, Under 20 hp (15 kw)
 - a) Under 400 rpm: 1 inch (25 mm)
 - b) 400 - 600 rpm: 1 inch (25 mm)
 - c) 600 - 800 rpm: 0.5 inch (12 mm)
 - d) 800 - 900 rpm: 0.2 inch (5 mm)
 - e) 1100 - 1500 rpm: 0.14 inch (4 mm)
 - f) Over 1500 rpm: 0.1 inch (3 mm)

PART 2 PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Open Spring Isolators:
 - 1. Spring Isolators:
 - a) For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b) Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 3. Spring Mounts: Provide with levelling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 - 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
- B. Restrained Spring Isolators:

1. Spring Isolators:
 - a) For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b) Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Provide with levelling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
5. Restraint: Provide heavy mounting frame and limit stops.

C. Closed Spring Isolators:

1. Spring Isolators:
 - a) For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b) Color code springs for load carrying capacity.
2. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

D. Spring Hanger:

1. Spring Isolators:
 - a) For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b) Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Housings: Incorporate [neoprene isolation pad meeting requirements for neoprene pad isolators] [rubber hanger with threaded insert].

4. Capable of 20 degree hanger rod misalignment.

E. Neoprene Pad Isolators:

1. Rubber or neoprene waffle pads.

a) 30 durometer.

b) Minimum 1/2 inch thick.

c) Maximum loading 40 psi.

d) Height of ribs shall not exceed 0.7 times width.

2. Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.

F. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install isolation for motor driven equipment.

C. Adjust equipment level.

D. Install spring hangers without binding.

E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

G. Provide pairs of horizontal limit springs on hanger supported, horizontally mounted fans.

H. Support piping connections to isolated equipment as follows:

1. Up to 4 Inch (100 mm) Diameter: First three points of support.

2. 5 to 8 Inch (125 to 200 mm) Diameter: First four points of support.

3. 10 inch (250 mm) Diameter and Over: First six points of support.

4. Select three hangers closest to vibration source for minimum 1.0 inch (25 mm) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch (25 mm) static deflection or 1/2 static deflection of isolated equipment.

I. Connect wiring to isolated equipment with flexible hanging loop.

END OF SECTION

SECTION 230553 – MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Ceiling Tacks.

1.2 REFERENCES

- A. ASME A13.1 Scheme for the Identification of Piping Systems.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Description: Laminated three layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1 1/2 inch diameter.
- B. Chart: Typewritten letter size list in 3-ring notebook.

2.3 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1 1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1 1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2 1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1 1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2 1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3 1/2 inch high letters.
 - 6. Ductwork and Equipment: 2 1/2 inch high letters.

- B. Stencil Paint: Semi gloss enamel, black on white background conforming to ASME A13.1.

2.4 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head; In addition, provide clear plastic label adjacent to ceiling tack indicating specific equipment identification tag
- B. Color code as follows:
 - 1. Yellow - HVAC equipment
 - 2. Red - Fire dampers/smoke dampers
 - 3. Green - Plumbing valves

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. All equipment requiring periodic maintenance or testing located in concealed spaces shall be clearly identified on an adjacent finished surface to identify the location of equipment. For equipment mounted above ceilings, provide an ID label on the ceiling below the equipment. Typical concealed equipment includes air terminals, air valves, PRVs, mixing valves, duct and pipe differential pressure sensors, steam traps, fire smoke dampers, etc. Labels shall be clear or white with 0.375" high black letters.
- B. Install plastic nameplates with corrosive resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- C. Install tags with corrosion resistant chain.
- D. Apply stencil painting in black on white background or color as coordinated with Engineer and Owner prior to beginning work.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in line pumps, may be identified with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify thermostats relating to terminal boxes or valves with nameplates.
- I. Identify valves in main and branch piping with tags.
- J. Identify air terminal units and associated valves with numbered tags.

- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify piping, concealed or exposed, with stencils. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- M. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- N. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

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SECTION 230593 – TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic steam systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 ALLOWANCES

- A. Work is included in this section and is part of the Contract Sum/Price.

1.3 REFERENCES

- A. AABC - National Standards for Total System Balance.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 PROJECT RECORD DOCUMENTS

- A. Record actual locations of flow and pressure measuring stations and balancing valves.

1.5 QUALIFICATIONS

- A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum five years documented experience certified by AABC.
- B. Perform Work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, or registered Professional Engineer experienced in performance of this Work and licensed in the State of North Carolina.

1.6 PRE BALANCING CONFERENCE

- A. Convene one month prior to commencing work. Include all pertinent contractors and designers.

1.7 SEQUENCING

- A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

- B. The test and balance report shall be completed, reviewed, and approved by project engineer prior to final inspection and occupancy. Preliminary/rough draft reports are not acceptable.

1.8 SCHEDULING

- A. Schedule and provide assistance in final adjustment and test of life safety and lab exhaust system

PART 2 PRODUCTS

This Part Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies noted.
- C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make technician and instruments available to Designer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for air conditioning systems and plus or minus 5 percent of design for exhaust systems.
- B. Where pressure relationship between adjacent spaces is called for, document compliance.

3.4 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

- A. For laboratory spaces, the transfer airflow rates listed on the plans are preliminary values. The Contractor shall adjust as necessary such that laboratory spaces are pressurized (either positive or negative) according to the intent shown on the drawings.
- B. Adjust air handling and distribution systems to provide required air quantities.
- C. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- D. Measure air quantities at air inlets and outlets.
- E. Adjust distribution system to obtain uniform space temperatures control.
- F. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct mounted devices.

- G. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- H. Provide system schematic with required and actual air quantities recorded at each outlet or inlet. Provide summary report with all test and equipment data included.
- I. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- J. Adjust automatic, outside air, return air, and exhaust dampers for design conditions.
- K. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- L. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- M. Measure building and/or system static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximate positive static pressure called for.
- N. Check all motorized dampers for leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- O. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on suitable temperature difference.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.7 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing

1. Chillers
2. Boilers
3. Heat Exchangers
4. Pumps
5. Air Coils
6. Terminal Heat Transfer Units
7. Air Handling System
8. Airflow Measuring Stations
9. Fans
10. Air Filters
11. Air Terminal Units
12. Air Inlets and Outlets
13. Duct Leakage Testing

B. Report Forms

1. Title Page:
 - a) Name of Testing, Adjusting, and Balancing Agency
 - b) Address of Testing, Adjusting, and Balancing Agency
 - c) Telephone number of Testing, Adjusting, and Balancing Agency
 - d) Project name
 - e) Project location
 - f) Project Architect
 - g) Project Engineer
 - h) Project Contractor
 - i) Project altitude
 - j) Report date
2. Summary Comments:

- a) Design versus final performance
 - b) Notable characteristics of system
 - c) Description of systems operation sequence
 - d) Summary of outdoor and exhaust flows to indicate amount of building pressurization
 - e) Nomenclature used throughout report
 - f) Test conditions
3. Instrument List:
- a) Instrument
 - b) Manufacturer
 - c) Model number
 - d) Serial number
 - e) Range
 - f) Calibration date
4. Electric Motors:
- a) Manufacturer
 - b) Model/Frame
 - c) HP/BHP
 - d) Phase, voltage, amperage; nameplate, actual, no load
 - e) RPM
 - f) Service factor
 - g) Starter size, rating, heater elements
 - h) Sheave Make/Size/Bore
5. V-Belt Drive:
- a) Identification/location
 - b) Required driven RPM
 - c) Driven sheave, diameter and RPM

- d) Belt, size and quantity
 - e) Motor sheave diameter and RPM
 - f) Center to center distance, maximum, minimum, and actual
6. Pump Data:
- a) Identification/number
 - b) Manufacturer
 - c) Size/model
 - d) Impeller
 - e) Service
 - f) Design flow rate, pressure drop, BHP
 - g) Actual flow rate, pressure drop, BHP
 - h) Discharge pressure
 - i) Suction pressure
 - j) Total operating head pressure
 - k) Shut off, discharge and suction pressures
 - l) Shut off, total head pressure
7. Air Moving Equipment
- a) Location
 - b) Manufacturer
 - c) Model number
 - d) Serial number
 - e) Arrangement/Class/Discharge
 - f) Air flow, specified and actual
 - g) Return air flow, specified and actual
 - h) Outside air flow, specified and actual
 - i) Total static pressure (total external), specified and actual

- j) Inlet pressure
 - k) Discharge pressure
 - l) Sheave Make/Size/Bore
 - m) Number of Belts/Make/Size
 - n) Fan RPM
8. Outside Air Data:
- a) Identification/location
 - b) Design air flow
 - c) Actual air flow
 - d) Design return air flow
 - e) Actual return air flow
 - f) Design outside air flow
 - g) Actual outside air flow
 - h) Return air temperature
 - i) Outside air temperature
 - j) Required mixed air temperature
 - k) Actual mixed air temperature
 - l) Design outside/return air ratio
 - m) Actual outside/return air ratio
9. Exhaust Fan Data:
- a) Location
 - b) Manufacturer
 - c) Model number
 - d) Serial number
 - e) Air flow, specified and actual
 - f) Total static pressure (total external), specified and actual

- g) Inlet pressure
 - h) Discharge pressure
 - i) Sheave Make/Size/Bore
 - j) Number of Belts/Make/Size
 - k) Fan RPM
10. Duct Traverse:
- a) System zone/branch
 - b) Duct size
 - c) Area
 - d) Design velocity
 - e) Design air flow
 - f) Test velocity
 - g) Test air flow
 - h) Duct static pressure
 - i) Air temperature
 - j) Air correction factor
11. Duct Leak Test:
- a) Description of ductwork under test
 - b) Duct design operating pressure
 - c) Duct design test static pressure
 - d) Duct capacity, air flow
 - e) Maximum allowable leakage duct capacity times leak factor
 - f) Test apparatus
 - (i) Blower
 - (ii) Orifice, tube size
 - (iii) Orifice size

(iv) Calibrated

- g) Test static pressure
- h) Test orifice differential pressure
- i) Leakage

12. Air Monitoring Station Data:

- a) Identification/location
- b) System
- c) Size
- d) Area
- e) Design velocity
- f) Design air flow
- g) Test velocity
- h) Test air flow

13. Flow Measuring Station:

- a) Identification/number
- b) Location
- c) Size
- d) Manufacturer
- e) Model number
- f) Serial number
- g) Design Flow rate
- h) Design pressure drop
- i) Actual/final pressure drop
- j) Actual/final flow rate
- k) Station calibrated setting

14. Terminal Unit Data:

- a) Manufacturer
 - b) Type, constant, variable, single, dual duct
 - c) Identification/number
 - d) Location
 - e) Model number
 - f) Size
 - g) Minimum static pressure
 - h) Minimum design air flow
 - i) Maximum design air flow
 - j) Maximum actual air flow
 - k) Inlet static pressure
15. Air Distribution Test Sheet:
- a) Air terminal number
 - b) Room number/location
 - c) Terminal type
 - d) Terminal size
 - e) Area factor
 - f) Design velocity
 - g) Design air flow
 - h) Test (final) velocity
 - i) Test (final) air flow
 - j) Percent of design air flow

END OF SECTION

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SECTION 230700 – INSULATION

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Work required under this section consists of insulation for piping and duct system and equipment specified in Division 23.
- B. Provide all necessary labor, materials, tools and equipment to perform work required on the drawings and specified herein.
- C. All pipe fittings, valves, and strainers to be insulated.
- D. Certain equipment and/or systems to be factory insulated by manufacturer. Factory insulation materials to be as specified in applicable sections of the specifications.

1.2 DEFINITIONS

- A. Thermal resistance “R” values are expressed in units of “Hour-Degrees F-sq. ft./Btu per inch of Thickness” on a flat surface at a mean temperature of 75 degrees F unless noted otherwise.
- B. Thermal conductivity (K), the reciprocal of "R", btu per inch thickness/hr/ft²/degree.
- C. Insulation to consist of insulating material, jacket, mastic, and adhesive, either as a “system” or as an individual component when used separately.

1.3 QUALITY ASSURANCE / CERTIFICATION

- A. Unless noted otherwise, all insulation, adhesives, coatings, sealers, and tapes to have a flamespread rating of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E-84, NFPA 225 AND UL 723.
- B. Apply insulation in a workmanlike manner using experienced, qualified tradesmen.
- C. Do not apply insulation until all pressure testing has been completed, inspected and released or insulation application.
- D. Clean and dry surfaces prior to insulation application.
- E. Butt insulation joints firmly together; smoothly and securely install all jackets and tapes.
- F. Insulation jacket for duct, pipe, and equipment exposed to weather to be certified as self-extinguishing in less than 53 seconds when tested in accordance with ASTM D1692.
- G. Certify that all duct and piping insulation meets the minimum requirements of the current State Energy Code for New Building Construction.

PART 2 PRODUCTS

2.1 MATERIALS FOR PIPE AND EQUIPMENT

- A. Provide factory premolded or shop mitered segment type insulation for pipe, fittings, and valves, unless otherwise noted.
- B. Fitting insulation to be of same thickness and material as adjoining pipe insulation.
- C. Cellular Glass (Foamglass)
 - 1. Product to be guaranteed by manufacturer to have continuous operational temperature limit of not less than 90 degrees F and minimum "R" value of 2.63.
 - 2. Provide Pittsburgh Corning "Foamglass" noncombustible factory-molded material.
 - 3. Provide factory applied pre-sized glass cloth jacket having an inside vapor barrier and white exterior color equivalent to Johns-Manville "Flame-Safe type "GVB".
 - 4. Provide for the following services:
 - a) Under pipe saddles where compressible piping insulation is used (Fiberglass, flexible elastomeric).
 - b) At all penetrations of rated walls and floors with insulated piping services.
- D. Flexible Elastomeric
 - 1. Provide AP Armaflex manufactured by Armstrong or equivalent.
 - 2. Provide 2-pound density, fire-retardant polyolefin, flexible type insulation, pre-formed tubular for piping and sheet for equipment.
 - 3. Maximum water vapor transmission rate of 0.03 perms per inch and UV stabilized with a guaranteed outdoor life of 10 years.
 - 4. Product to have continuous operational temperature limit of not less than 210 degrees F and a minimum "R" value of 3.71.
 - 5. Provide white, self-seal Armaflex 2000 manufactured by Armstrong for 1/2 inch application thickness.
 - 6. Provide insulation for the following services:
 - a) Copper or steel moisture condensate drains: 1/2-inch thick.
 - b) Pump casings below 60o service: 1-1/2" thick.
 - c) Run-outs to terminal units and split systems: 1-1/2" thick.
- E. Glass Fiber
 - 1. Provide factory-formed, factory-jacketed "system" type fiberglass insulation.
 - 2. Jacket to be fiberglass reinforced, white kraft paper with aluminum foil vapor barrier.

3. Insulation density to be not less than 3.5 pounds per cubic foot.
4. Product to have continuous operational temperature limit of no less than 650 degrees F and a minimum "R" value of 4.00.
5. Product to be equivalent to Manville "Micro-Lok 650" with Type AP jacketing. Applicable products manufactured by Certainteed, Knauf, Owens Corning or Blue Trymer 2000 are acceptable
6. Provide insulation for following services:
 - a) Heating hot water and low pressure steam piping:
 - (i) 1-1/2 inch diameter and smaller hot water and steam piping: 1-1/2" thick.
 - (ii) Above 1-1/2 inch hot water piping: 2" thick.
 - (iii) Above 1-1/2 inch steam piping: 3" thick
 - b) Domestic cold water make-up piping (inside building): 1/2- inch thick.
 - c) Tanks: 2"

F. Rigid Foam Insulation

1. Insulation shall be polyisocyanurate foam or Styrafoam with a K value (90 days aged) of .20 at a mean temperature of 75 degrees F. Density shall be 2#/cu. ft., flame spread less than 30 and smoke density less than 150 in 4" thickness. Insulation shall not be used in plenums. All joints and seams shall be neatly sealed in place with Foster 95-50 vapor barrier adhesive.
2. Valves and fittings shall be insulated with same material and to the same thickness as adjoining pipe. When insulating flanges and valve bodies, insulation shall extend a minimum of 1" beyond the end of the flange bolts and the bolt area shall be filled with fiberglass before molded insulation is applied.
3. Fill small voids with approved sealer before finish is applied.
4. Provide a one-piece Zeston type fitting jacket as recommended by the manufacturer for the applicable design conditions.
5. Clean and apply bitumen coating prior to applying rigid foam insulation.
6. Apply on:
 - a) Chilled Water piping: 1-1/2" thick.
 - b) Chilled water specialties, except those insulated with flexible foam: 1-1/2" thick.
 - c) Condenser Water Piping (Outside, above ground): 1" thick.
 - d) Make-up water and drain piping subject to freezing at cooling tower: 1" thick.

2.2 MATERIALS FOR DUCTS

A. Blanket Type Insulation

1. Provide minimum 1 pound per cubic foot density, flexible, factory reinforced glass fiber blanket with foil-faced, glass-fiber reinforced kraft vapor barrier jacket. Provide 1.5 pcf with vinyl jacket where noted.
2. Insulation to have a minimum installed "R" value of 3.92.
3. Product to be manufactured by Manville, or equivalent by Certainteed, Knoff, or Owens-Corning.
4. Provide glass fiber blanket insulation for the following:
 - a) Unlined hot air or cold air supply ducts concealed from view (except where noted otherwise): 2 inch thick.

B. Glass fiber Board Type Insulation

1. Provide minimum 3 pound per cubic foot density semi-rigid insulation with factory applied reinforced foil faced kraft vapor barrier glass fiber board "system" type insulation.
2. Insulating board to have a minimum "R" value of 4.34.
3. Product to be manufactured by Manville, or equivalent by Certainteed, Knoff, or Owens Corning.
4. Provide glass fiber board insulation for the following:
 - a) Ducts within equipment rooms and exposed to view: 1-1/2 inch thick.
 - b) Ductwork located outside of building or outside of building insulation system: 2-inch thick
 - c) Unlined apparatus casing: 1-1/2 inch thick.

C. Exhaust ductwork shall not be insulated.

2.3 ELECTRICAL HEAT TAPE

- A. Furnish and install electrical, self-regulating heat tape at locations indicated on drawings.
- B. Furnish Raychem XL-Trace Self-regulating type completed with splicers, connectors and other accessories.
- C. Unless otherwise noted, provide the following minimum heat densities:
 1. Outdoor condenser water piping (including centrifugal separator piping): 5 watts per linear foot.

2. Outdoor chilled water, hot water, and domestic cold water makeup piping: 5 watts per linear foot.
 3. Outdoor cooling tower drain piping: 5 watts per linear foot.
- D. Install heat tape underneath, insulation and jackets specified in this section.
- E. Provide ambient air sensing thermostat to switch the heat tape off when ambient conditions rise above setpoint. Provide one thermostat for each circuit.

2.4 MATERIALS FOR FITTING AND VALVES

- A. Premolded or mitered and fitted insulation and one-piece PVC insulated fitting covers.
- B. Provide factory pre-molded one-piece PVC insulated fitting covers, precut insulation inserts and installation materials for the following services:
1. All pipe fittings and valves.
 2. All grooved coupling installations.
- C. Materials to be equal to Foster Seaglass PVC fitting cover, UNI-Fit inserts and accessories, or equivalent by Molded Acoustical Products, Inc., Hamfab, Zeston division of Mansfield; or Armstrong Products.

2.5 COATINGS, FINISHES AND JACKETS

- A. Piping and Equipment:
1. Prior to application of all pipe insulation, pipe surfaces shall be cleaned of rust and debris and painted. Prior to starting painting, Engineer and/or CM shall approve pipe when cleaned and painted.
 2. All chill water piping and all piping in Mechanical Rooms shall be painted with one coat of rust proof paint after cleaning and prior to application of insulation. Paint on hot water, steam and condensate piping shall be high temperature.
 3. For pipe, fittings and valves through 1-1/2-inch size in systems exposed-to-view inside building or in equipment rooms, finish to be PVC factory jacket.
 4. For tanks, heat exchangers, insulated equipment and pipes 2" and larger in systems exposed inside building or in equipment rooms, cover insulation with one layer of 8 oz. canvas and finish with fire retardant logging adhesive ready for painting.
 5. Fitting Jackets: Inside use PVC molded one-piece or matching 2-piece jacket.
 - a) Hot surfaces; apply with stainless steel tacks or staples.
 - b) Cold surface; use 2" wide, 10 mil vinyl tape furnished by manufacturer of jacket. Where vapor barrier is required, apply tape to jacket and vapor barrier on pipe before canvas is applied.

6. For any service when above grade and exposed to the weather outside building, cover pipe insulation with 0.016-inch thick aluminum jacket.
7. Do not insulate valves in systems operating above 60 degrees F. Paint valves with a rust-resistant product equivalent to Rustoleum.
8. For flexible tubular elastomeric pipe and fitting insulation when exposed-to-view inside building or exposed to the weather, finish with two coats of fire retardant self-extinguishing vinyl lacquer type flexible coating equivalent to Armstrong "Armaflex Finish".

B. Ducts

1. In Equipment Rooms and where exposed to view: 8 oz canvas treated with fire retardant lagging adhesive. Seal joints and seams with 3" aluminum tape. Reinforce corners.

PART 3 EXECUTION

3.1 GENERAL

- A. All surfaces to be clean and dry (and painted where noted above) when covering is applied. Covering to be dry when installed and during application of any finish.
- B. All adhesives, cements and mastics to be compatible with materials applied without attacking materials in either wet or dry state.
- C. Insulation Exposed to view to have a well tailored appearance.
- D. Do not insulate expansion tanks or heads of hot water pumps.
- E. Install all insulation in accordance with manufacturer's instructions.

3.2 PENETRATION OF RATED WALLS, PARTITIONS & FLOORS

- A. Do not pass pipe insulation through fire rated partitions or floors unless firestopping system is listed for insulated pipe. Stop and properly terminate insulation at each side of partition.
- B. Install foamglass insulation on chilled water piping where lines pass through rated partitions.
- C. Stop all duct coverings including jacket and insulation at all penetrations of rated walls. Flare-out or extend insulation jacket at least 2-inches beyond angle frames of fire dampers and seal to structure.
- D. Maintain vapor barrier.
- E. Install covering over damper and smoke detector access doors readily removable and identifiable.

3.3 INSTALLATION OF DUCT INSULATION

- A. Install in accordance with TIMA National Insulation Standards.
- B. Insulated ductwork conveying air below ambient temperature:

1. Provide insulation with vapor barrier jacket.
 2. Finish with tape and vapor barrier jacket.
 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ductwork conveying air above ambient temperature:
1. Provide with or without standard vapor barrier jacket.
 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. Blanket type insulation
1. Apply jacketed blanket type glass fiber pulled snug to ducts but not more than 1/2-inch compression at corners.
 2. Use insulation having 2-inch tab, or cut insulation long enough to allow for "peel-off" of insulation from jacket to effect a minimum overlap tab of 2-inch.
 3. Staple lap with flare type staples on 1-inch centers.
 4. Cover standing seams, stiffeners, and braces with an insulation blanket, using 2-inch jacket lap and staple lap.
 5. Cover and seal all staples and attachment pins with foster 30-35 reinforced with glass cloth or FSK tape.
 6. Apply insulation with approved adhesive and weld pins at 18" o.c. on the bottom of ducts 16" or wider. Provide pins at 18" o.c. on sides of ducts 20" or more. Vertical ducts that are larger than 16" shall have weld pins on all sides. Overlap facing 3" and seal with approved adhesive or apply reinforced aluminum tape. Seal punctures and breaks with aluminum tape.
- E. Jacketed Board Type Insulation:
1. Apply jacketed board type insulation to ducts using adhesive and weld pins or nylon "Stick-clip" plates having self-locking, coated metal or nylon discs.
 2. If insulation is grooved for corners, pin as required to hold insulation tight to duct.
 3. Seal pins and joints with Foster 30-56 reinforced with glass cloth or FSK tape.
 4. Insulation shall be applied to the ductwork using approved adhesive and mechanical fasteners such as weld pins or stick clips located not less than 3" from each edge or corner of the board. Pin spacing along the duct not greater than 12" o.c. Additional fasteners used on the sides and bottom of all ducts at a maximum spacing of approximately 18" o.c. All edges and joints

sealed with 5" wide aluminum vapor barrier tape applied with Foster 85-20 adhesive. All punctures in the vapor barrier facing likewise sealed

5. Cover all joints, rips, tears, punctures, disc heads, staples, or breaks in vapor barrier jacket with 4-inch wide woven glass fabric tape embedded in equivalent of Childers CP-82 or Benjamin-Foster No. 85-20 "Sparkfast" vapor barrier fire resistant adhesive. Pressure sensitive tape permitted if recommended by manufacturer.
6. Cover all board type insulation with 8 oz. canvas jacket applied with fire retardant logging adhesive.

F. Rigid Foam Insulation

1. Apply with adhesive as recommended and weld pins or "Stock-clips" having self locking metal or nylon discs.
2. Place pins 3" from edges and not more than 18" O.C.
3. Seal all joints and pin penetrations with 3" wide aluminum tape or as recommended by the manufacturer.
4. Finish insulation with 2 coats of Armaflex white paint.

3.4 INSTALLATION OF PIPE INSULATION

- A. Install in accordance with TIMA National Insulation Standards.
- B. Exposed Piping: Cover insulation with 8 oz canvas or factory jacket as noted above. Locate seams in least visible locations. Size canvas for painting. Paint (color as noted herein or as required by owner) canvas and PVC fitting covers.
- C. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. Glass fiber insulated pipes conveying fluids below ambient temperature:
 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe and PVC fitting covers.
- E. Glass fiber insulated pipes conveying fluids above ambient temperature:
 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

- F. Insulation above furred ceiling and in chases requires no finish beyond factory jacket.
- G. Inserts and Shields:
 - 1. Shields: Galvanized steel between pipe hangers or hanger rolls and insulation.
 - 2. Insert location: Between support shield and piping and under the finish jacket.
 - 3. Insert configuration: Minimum 12" inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 4. Insert material: Hydrous calcium silicate or foamglas insulation material suitable for the planned temperature range.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire and smoke separations, refer to Section 230500.

3.5 INSTALLATION OF EQUIPMENT COVERING

- A. Factory Insulated Equipment: Do not insulate, except as otherwise noted.
- B. Apply insulation close to equipment by grooving, scoring, and bevelling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands as appropriate.
- C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- D. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- E. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- F. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- G. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- H. Finish insulation at supports, protrusions, and interruptions.
- I. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- J. Exterior Applications: Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
- K. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

- L. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed for inspection.

3.6 INSTALLATION OF ONE-PIECE PVC INSULATED FITTING COVERS

- A. Premolded fitting covers to be precisely cut or mitered to fit or be tucked snugly into the throat of fitting and edges adjacent to pipe covering and taped to form a fully insulated pipe covering.
- B. Use adhesive and/or tape specified for type of insulation to insure a thorough vapor barrier.
- C. Tape ends securely to adjacent pipe covering. Tape to extend over adjacent pipe insulation with an overlap of at least 2-inch on both side

END OF SECTION

SECTION 230913 – INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 ACTUATORS AND OPERATORS

1.1 General Requirements

- A. Damper and valve actuators shall be electronic, as specified in the System Description section.

1.2 Electronic Damper Actuators

A. Spring Return Actuators:

1. Regulatory Agency Listing: cULus ,CSA C22.2 No. 24-93, and CE marked
2. Direct-Coupled Design: Requires no crankarm or linkage for mounting to a shaft.
3. Coupling: toothed V-bolt clamp and nuts with toothed cradle.
4. Reversible Mounting: Provides either clockwise or counterclockwise operation.
5. Power Failure Operation: Mechanical spring return system drives load to the home position. Other forms of internal energy storage for power failure operation are not acceptable.
6. Motor Technology:
 - (i) Modulating Types: Microprocessor-controlled Brushless DC motor
 - (ii) On/Off Types: DC brush motor.
7. Overload Protection: Electronic stall detection protects from overload at all angles of rotation without the use of end switches.
8. Enclosure Ratings:
 - a) NEMA type 2 / IP54 mounted in any orientation.
9. Double-Insulated construction: Eliminate the need for electrical ground wires.
10. Wiring: Integral cables with colored and numbered conductors.
11. Sized for torque required to seal damper at load conditions
12. Parallel Operation: Actuators shall be available that are capable of being mechanically or electrically paralleled.
13. Proportional actuators shall be user configurable without the use of external computer software or programming tools. Calibration, input signal range selection, and control logic reversal shall be selectable with an external mode selection switch.
14. Operating Temperature Range:
 - a) 70 lb·in. Torque and below: -40°F to 140°F

- b) 71 lb·in. Torque and above: -40°F to 131°F
15. Power Requirements:
- a) Modulating Types:
 - (i) 27 lb·in. Torque and Below: 5VA maximum
 - (ii) 70 lb·in. to 19 lb·in. Torque: 8VA maximum
 - (iii) 89 lb·in. to 71 lb·in. Torque: 10VA maximum
 - (iv) 90 lb·in. to 177 lb·in. Torque: 16VA maximum
 - b) 2-Position Types:
 - (i) 27 lb·in. Torque and Below: 5VA maximum
 - (ii) 70 lb·in. to 19 lb·in. Torque: 7VA maximum
 - (iii) 71 lb·in. to 177 lb·in. Torque: 25VA maximum
- B. Non-Spring Return Actuators:
1. Regulatory Agency: UL Listed ,CSA Certified, and CE marked
 2. Direct-Coupled Design: Requires no crank arm or linkage for mounting to a shaft.
 3. Coupling:
 - a) Above 80 lb·in.: toothed V-bolt clamp and nuts with toothed cradled
 - b) 80 lb·in. and below: single cup-point set screw and toothed cradle.
 4. Overload Protection: Electronic stall detection or magnetic slip clutch protects from overload at all angles of rotation without the use of end switches.
 5. Minimum Enclosure Ratings:
 - a) Types with covered wiring terminals: NEMA type 2 / IP42 mounted in any orientation.
 - b) Types without covered wiring terminals: NEMA type 1 / IP30 or IP40.
 - c) Types with integrated cables: NEMA 2 / IP42 mounted in any orientation.
 6. Sized for torque required to seal damper at load conditions
 7. Parallel Operation: Actuators shall be available that are capable of being mechanically or electrically paralleled.
 8. Proportional actuators shall be user configurable without the use of external computer software or programming tools.

9. Operating Temperature Range: -4°F to 122°F except for VAV and similar indoor applications in which case 32°F to 122°F is acceptable.
10. Power Requirements: 24 V with models available for both 24 VAC and 24 VDC operation, maximum
 - a) Above 80 lb·in.: 7.5 VA at 24 VAC
 - b) 80 lb·in. and below: 3.5 VA at 24VAC
11. The manufacturer shall provide 5-year limited warranty from the date of sale covering defects in material or workmanship.

PART 2 SENSORS AND TRANSMITTERS

2.1 General Requirements

- A. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

2.2 Temperature Sensors

A. General Requirements:

1. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
2. The temperature sensor shall be of the resistance type and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
3. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	± .5°F.
Room Temp	± .5°F.
Duct Temperature	± .5°F.
All Others	± .75°F.

B. Room Temperature Sensors

1. Room sensors shall be constructed for either surface or wall box mounting.
2. Room sensors shall have the following options when specified:

- a) Setpoint warmer/cooler dial or reset slide switch providing a +3 degree (adjustable) range.
 - b) Individual heating/cooling setpoint slide switches.
 - c) A momentary override request push button for activation of after-hours operation.
 - d) Analog thermometer.
- C. Room Temperature Sensors with Integral Display
1. Room sensors shall be constructed for either surface or wall box mounting.
 2. Room sensors shall have an integral LCD display and either a setpoint adjustment dial or setpoint adjustment push buttons, and the following capabilities when specified:
 - a) Display room air temperatures.
 - b) Display and adjust room comfort setpoint.
 - c) Display and adjust fan operation status via push button.
 - d) Timed Override request via Occupancy Override push button with LED status for activation of after-hours operation.
 - e) Override request via setpoint adjustment dial or setpoint adjustment push buttons for activation of after-hours operation.
 - f) Occupancy sensor
 - g) F/C toggle pushbutton to toggle between F and C.
 - h) RH%/Temperature toggle push button to temporarily display RH%
- D. Thermo-wells
1. Thermo-well manufacturer shall have models available in stainless steel, brass body, and copper bulb.
 2. When thermo-wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and sensor.
 3. Thermo-wells shall be pressure rated and constructed in accordance with the system working pressure.
 4. Thermo-wells and sensors shall be mounted in a direct mount (no adapter) offering faster installation or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.
 5. Thermo-wells constructed of 316 stainless steel shall comply with Canadian Registration Number (CRN) pressure vessel rating.
- E. Outside Air Sensors

1. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
2. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
3. Temperature transmitters shall be of NEMA 3R (IP54) or NEMA 4 (IP65) construction and rated for ambient temperatures.
4. The outdoor sensor can be easily mounted on a roof, pole or side of a building utilizing its already assembled mounting bracket.
5. Outside Relative Humidity sensors 0-100% full range of accurate measurement. Operating temperature -4 to 140F (-20 to 60C).
6. Outside temperature sensors operating temperature range is -40 to 140F, +/- .55F (+/- .3C).

F. Duct Mount Sensors

1. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
2. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
3. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

G. Averaging Sensors

1. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
2. For plenum applications, such as mixed air temperature measurements, a continuous averaging sensor or a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
3. Capillary supports at the sides of the duct shall be provided to support the sensing string.

H. Humidity Sensors

1. The sensor shall be a solid-state type, relative humidity sensor of the Thin Film Capacitance or Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 degrees F unless specified elsewhere.

4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R (IP54) or NEMA 4 (IP65) enclosure with sealite fittings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

2.3 CO2 Sensors

- A. Where shown on the drawings, CO2 sensors shall have the following features:
 1. Jumper selectable: 0-20mA, 4-20mA & 0-10VDC output
 2. Liquid Crystal Display
- B. The CO2 sensors shall have the ability to monitor and output the following variables as required by the systems sequence of operations:
 1. Zone carbon-dioxide
- C. The CO2 shall transmit the information back to the controller via jumper selectable 0-20mA, 4-20mA & 0-10VDC output signals.
 1. The CO2 sensors shall provide a maximum output current of 25mA; Maximum output voltage of 12.5V.
 2. The CO2 sensors shall be FCC compliant to CFR47 Part 15 subpart B Class A.
- D. The CO2 Sensors shall be available with
 1. CO2 response time (0-63%) of 1 minute
 2. Less than 0.083% of full scale/F° temperature dependence of CO2 output
 3. Long term CO2 stability $\pm 5\%$ of full scale for 5 years
 4. CO2 measurement accuracy of $\pm (40\text{ppm} + 2.0\%$ of reading)
 5. CO2 non-linearity of less than 1.0% of full scale
- E. The CO2 Sensors may include the following items:
 1. Relay output module
 2. Liquid Crystal Display module
 3. Analog temperature module with linear 0-10VDC output for 32-122F

2.4 Differential Pressure Transmitters

A. General Air and Water Pressure Transmitter Requirements:

1. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
2. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
3. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
4. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

B. Low Differential Water Pressure Applications (0" - 20" w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - a) .01-20" w.c. input differential pressure range.
 - b) 4-20 mA output.
 - c) Maintain accuracy up to 20 to 1 ratio turndown.
 - d) Reference Accuracy: +0.2% of full span.
3. Acceptable Manufacturers: Setra and Mamac.

C. Medium to High Differential Water Pressure Applications (Over 21" w.c.)

1. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
 - a) Differential pressure range 10" w.c. to 300 PSI.
 - b) Reference Accuracy: +1% of full span (includes non-linearity, hysteresis, and repeatability).
2. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
3. Acceptable Manufacturers: Setra and Mamac.

D. Building Differential Air Pressure Applications (-1" to +1" w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - a) -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
 - b) 4-20 mA output.
 - c) Maintain accuracy up to 20 to 1 ratio turndown.
 - d) Reference Accuracy: +0.2% of full span.

E. Low Differential Air Pressure Applications (0" to 2.5" w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - a) (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
 - b) 4-20 mA, 0-5 VDC, 0-10 VDC, output.
 - c) Maintain accuracy up to 20 to 1 ratio turndown.
 - d) Reference Accuracy: +0.25%, or 0.5% of full span.
 - e) Acceptable Manufacturers: Ruskin, or approved equal

F. Medium Differential Air Pressure Applications (5" to 21" w.c.)

1. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
 - a) Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
 - b) Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
 - c) Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70 degrees F.).
2. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the

panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

3. Acceptable manufacturers: Ruskin or approved equal

2.5 Flow Monitoring

A. Air Flow Monitoring

1. Fan Inlet Air Flow Measuring Stations

- a) At the inlet of each fan and near the exit of the inlet sound trap, airflow sensors shall be provided that shall continuously monitor the fan air volumes or velocity pressure.
- b) Each sensor shall be surface mount type. Unit shall be capable of monitoring and reporting the airflow and temperature at each fan inlet location through two or four sensing circuits. If a static pressure manifold is used, it shall incorporate dual offset static tips on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as + 20 degrees in the approaching air stream.
- c) Devices creating fan performance degradation, resulting in additional energy consumption, caused from pressure drop associated with probes or mounting apparatus in the center of the fan inlet are not allowed. The device shall not induce a significant pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Sensor circuit casings shall be constructed of U.L. 94 flame rated, high impact ABS and include a stainless steel thermistor cap that maintains the precise calibrated flow over the heated and ambient measurement points. Each sensor circuit shall consist of two ceramic base, glass encapsulated, thermistors for measuring ambient temperature and velocity. Circuit shall be designed for operation in a wide range of environments, including high humidity (non-condensing) and rapid thermal cycling.
- d) Acceptable manufacturers are: Air Monitor Corp., Tek-Air Systems, Inc., or Dietrich Standard.

B. Single Probe Air Flow Measuring Sensor

1. The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a thermal dispersion and utilize one temperature sensor and a heated thermistor. The sensor pair shall measure the air temperature and airflow velocity.

C. Duct Air Flow Measuring Stations

1. Furnish and install, at locations shown on plans or as in accordance with schedules, an equalized air measuring probe system piped to a high performance pressure transducer or an electronic type airflow temperature measuring station.
2. Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.

3. Assembly shall be AMCA tested and capable of measuring a range from 70 to 5,000 FPM (22 to 1524 MPM).
4. Equalized air measuring assembly shall measure to $\pm 3\%$ average and consist of 6063T5 extruded aluminum step sensing blade(s) with anodized finish, plenum-rated polyethylene pressure tubing, brass barbed fittings, mounting hardware and a glass-on-silicone capacitance sensor pressure transducer capable of measuring up to five field-selectable pressure ranges up to 2.5 in. w.c.
5. The transducer shall be accurate to $\pm 0.5\%$, or 0.25% of full scale and be contained in a National Electrical Manufacturer's Association (NEMA) 4 (IP-65) enclosure. Transducer shall be factory mounted and piped to high and low pressure ports through fittings made of brass.
6. All sensor tubing shall terminate in solid brass barbed fittings.
7. Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.
8. Air straightener shall be provided for sizes over 17 square feet (1.6 sq. meter).
9. Airflow measuring station assemblies shall be fabricated of galvanized steel or aluminum casing of appropriate thickness for slip fits or with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4" maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 5000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area and eliminate turbulent and rotational flow from the air stream prior to the measuring point.
10. Electronic air measuring station shall be capable of monitoring and reporting the airflow and temperature at each measuring location through one or more measuring probes containing multiple sensor points and a control transmitter that outputs a 4-20 mA linear signal.
11. Probe(s) shall be constructed of an airfoil shaped aluminum extrusion containing the sensor circuit(s).
12. Each sensor circuit shall consist of coated thermistors, for temperature and velocity, mounted to a Printed Circuit Board (PCB).
13. Probe multiplexer circuit(s) shall include a microprocessor that collects data from each PCB and digitally communicates the average airflow and temperature of each probe to a microprocessor based control transmitter.
14. Multiplexer board shall be encased to prevent moisture damage.
15. Shielded CAT5e communications cable shall be Underwriters Laboratories Inc.® (UL) plenum-rated with RJ45 terminal connectors. Dust boot covers and gold-plated contacts shall link probes to electronic controller.

16. Control transmitter shall be capable of processing independent sensing points and shall operate on a fused 24 VAC supply.
17. Control transmitter shall feature a 16 x 2 character alphanumeric LCD screen, digital offset/gain adjustment, continuous performing sensor/transmitter diagnostics, and a visual alarm to detect malfunctions.
18. All electronic components of the assembly shall be Restriction of Hazardous Substances (RoHS) Directive compliant.
19. Installation Considerations
 - a) The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .04" w.c. at 1000 feet per minute, or .11" w.c. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 3-5% as determined by AMCA.
 - b) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be 1.5 inches to facilitate matching connecting ductwork.
 - c) Where control dampers are shown as part of the airflow measuring station, parallel blade precision controlled volume dampers integral to the station and complete with actuator, and linkage shall be provided.
 - d) Stations shall be installed in strict accordance with the manufacturer's published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.
20. All air measuring devices shall be tested according to AMCA Standard 610
21. Acceptable manufacturers: Air Monitor Corp., Tek-Air, Ruskin, and Dietrich Standard.

D. Static Pressure Traverse Probe

1. Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.

E. Shielded Static Air Probe

1. A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.

F. Water Flow Monitoring

1. Water flow meters shall be electromagnetic type with integral microprocessor-Based electronics. The meter shall have an accuracy of 0.25%.
2. Acceptable manufacturers: Onicon

2.6 Power Monitoring Devices

A. Current Measurement (Amps)

1. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
2. Current Transformer – A split core current transformer shall be provided to monitor motor amps.
 - a) Operating frequency – 50 - 400 Hz.
 - b) Insulation – 0.6 Kv class 10Kv BIL.
 - c) UL recognized.
 - d) Five amp secondary.
 - e) Select current ration as appropriate for application.
3. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
 - a) 6X input over amp rating for AC inrushes of up to 120 amps.
 - b) Manufactured to UL 1244.
 - c) Accuracy: +.5%, Ripple +1%.
 - d) Minimum load resistance 30kOhm.
 - e) Input 0-20 Amps.
 - f) Output 4-20 mA.
 - g) Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).

2.7 Refrigerant Leak Detectors

- A. The refrigerant leak detector shall be a standalone device and shall provide a SPDT output to directly energize the refrigeration room exhaust ventilation fans. The detector shall include a sensor or sensors connected to a control panel. Two relay contacts at the control panel shall provide trouble and alarm indication to the Facility Management System. The alarm relay contact shall also directly energize the exhaust fans.
- B. The refrigerant leak detector shall sense the type of refrigerant used in the specified chillers. Multiple sensors shall be required to detect different refrigerants and/or provide proper sensing coverage for the area of the refrigeration room.

2.8 Smoke Detectors

- A. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 16 for installation under Division 15. All wiring for air duct detectors shall be provided under Division 16, Fire Alarm System.

2.9 Status and Safety Switches

A. General Requirements

1. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

B. Current Sensing Switches

1. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
2. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
3. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

C. Air Filter Status Switches

1. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
2. A complete installation kit shall be provided including static pressure tops, tubing, fittings, and air filters.
3. Provide appropriate scale range and differential adjustment for intended service.

D. Air Flow Switches

1. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.

E. Air Pressure Safety Switches

1. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.

2. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.

F. Low Temperature Limit Switches

1. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
2. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
3. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

2.10 Control Relays

A. Control Pilot Relays

1. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
2. Mounting Bases shall be snap-mount.
3. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
4. Contacts shall be rated for 10 amps at 120VAC.
5. Relays shall have an integral indicator light and check button.

B. Lighting Control Relays

1. Lighting control relays shall be latching with integral status contacts.
2. Contacts shall be rated for 20 amps at 277 VAC.
3. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
4. Lighting control relays shall be controlled by:
 - a) Pulsed tri-state output – Preferred method.
 - b) Pulsed paired binary outputs.
 - c) A Binary Input to the Facility Management System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the “dry-contact” type.
 - d) The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state.

Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

C. Electronic Signal Isolation Transducers

1. A signal isolation transducer shall be provided whenever an analog output signal from the BMS is to be connected to an external control system as an input (such as a chiller control panel) or is to receive as an input signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.
4. Electronic/Pneumatic Transducers
 - a) Electronic to Pneumatic transducers shall provide:
 - (i) Output: 3-15 PSIG.
 - (ii) Input: 4-20 mA or 0-10 VDC.
 - (iii) Manual output adjustment.
 - (iv) Pressure gauge.
 - (v) External replaceable supply air filter.

D. Thermostats

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

PART 3 CONTROL VALVES

3.1 Ball Valves, 1/2 through 2 in.:

- A. Ball Valves shall have forged brass bodies.
- B. Valves shall have available either Chrome Plated Brass Balls or 300 Series Stainless Steel Balls in all sizes.
- C. Valves shall have available either Nickel Plated Brass Stems or 300 Series Stainless Steel Stems with a blow-out proof stem design in all sizes.
- D. Valves shall have Graphite reinforced Polytetrafluoroethylene (PTFE) seats with Ethylene Propylene Diene Monomer (EPDM) O-ring backing.
- E. Stem seals shall be double EPDM O-rings.

- F. Flow Characterization Disk shall be manufactured from Amodel AS-1145HS Polyphthalamide Resin and rated for 50 psid maximum differential pressure and shall be inserted against the casting of the valve.
- G. All ball valves with internal pipe thread end connections shall be rated to 580 psi maximum static pressure at 203°F (95°C) fluid temperature.
- H. All ball valves with sweat end connections or press end connection shall be rated to 300 psig maximum static pressure at 203°F (95°C) fluid temperature
- I. All valves shall be rated for service with hot water, chilled water and 50% glycol solutions.
- J. Ball Valves with stainless steel balls and stems shall be rated for use with 15 psig saturated steam.
- K. Flow Characteristics shall be equal percentage on the control port. Bypass port on three-way valves shall have linear flow characteristics.
- L. Valves shall have a maximum leakage specification of 0.01% of maximum flow for the control port, ANSI/FCI 70-2, Class 4 and 1% of maximum flow, bypass port.
- M. Valves shall be maintenance free
- N. Valves shall be provided with a 5 year warranty.
- O. Valves shall be rated for 200 psid close off pressure.
- P. Valve actuators shall be UL-recognized or CSA-certified.

3.2 Ball Valves, 2-1/2 through 4 in. Flanged:

- A. Ball Valves shall have forged brass bodies with ASME Class 150 ductile iron flanges.
- B. Valves shall have 300 Series Stainless Steel Balls.
- C. Valves shall have 300 Series Stainless Steel Stems with a blow-out proof stem design.
- D. Valves shall have Graphite reinforced Polytetrafluoroethylene (PTFE) seats with Ethylene Propylene Diene Monomer (EPDM) O-ring backing.
- E. Stem seals shall be double EPDM O-rings.
- F. Flow Characterization Disk shall be manufactured from Amodel AS-1145HS Polyphthalamide Resin and rated for 50 psid maximum differential pressure.
- G. Flow Characteristics shall be equal percentage on the control port. Bypass port on three-way valves shall have linear flow characteristics.
- H. Valves shall have a maximum leakage specification of 0.01% of maximum flow for the control port, ANSI/FCI 70-2, Class 4 and 1% of maximum flow, bypass port.

- I. All valves shall be rated for service with hot water, chilled water, 50% glycol solutions and rated for use with 25 psig saturated steam.
- J. Two-Way Valves shall be rated for 100 psid close off pressure and Three-Way Valves shall be rated for 50 psid close off pressure.
- K. Valves shall be maintenance free.
- L. Valves shall be provided with a 5 year warranty.
- M. Valve actuators shall be UL-recognized or CSA-certified.

3.3 Butterfly Valves, 2 through 20 in. resilient seat ASME Class 125/150 Flanged:

- A. Butterfly Valves shall have cast iron bodies meeting ASTM A126 Class B requirements and meet ASME class 125/150 flange requirements and shall be fully lugged.
- B. Butterfly Valves seat shall be Ethylene Propylene Diene Monomer (EPDM).
- C. Butterfly Valve disk shall be Ductile Iron with Nylon 11 coating.
- D. Butterfly Valve stems shall be Stainless Steel.
- E. Flow Characteristics shall be equal percentage up to 70° of disk rotation.
- F. All valves shall be rated for service with hot water, chilled water and 50% glycol solutions.
- G. Valves shall be maintenance free.
- H. Valve shall be provided with a 3 year warranty.
- I. Valve electric actuators shall be UL-recognized or CSA-certified.

3.4 Butterfly Valves, High Performance 2-1/2 through 16 in.

- A. Butterfly Valves shall have bodies manufactured from Carbon Steel, ASTM A216 GR WCB/A516 GR 70 and shall be fully lugged per ASME Class 150 or ASME Class 300.
- B. Butterfly Valves seat assembly shall be RPTFE (reinforced polytetrafluoroethylene) and the seat retainer shall be Carbon Steel, ASTM A516 GR 70
- C. Butterfly Valve disk shall be Stainless Steel, ASTM A 351 GR CF8M
- D. Butterfly Valve stems shall be 17-4 PH Stainless Steel, ASTM A564-Type 630
- E. Butterfly Valve Stem Seals shall be One Carbon Fiber Ring and Three TFE Rings
- F. Flow Characteristics shall be equal percentage up to 70° of disk rotation.
- G. All valves shall be rated for service with hot water, chilled water, 50% glycol solutions and 50 psig saturated steam in modulating service or 150 psig saturated steam in two position service.

- H. Butterfly Valves shall meet the performance requirements of ASME Class 150 or Class 300.
- I. Valves shall be maintenance free.
- J. Valves shall be provided with a 3 year warranty.
- K. Valve electric actuators shall be UL-recognized or CSA-certified.

3.5 Globe Valves, Brass, 1/2 through 2 in.

- A. Valves shall have bodies manufactured from a RoHS compliant brass.
- B. Valves shall meet the pressure and temperature requirements of ANSI B16.15, Class 250
- C. Valve stems shall be a 300 Series Stainless Steel.
- D. Valves with brass plug and seat shall have stem seals with Self-Adjusting Ethylene Propylene Rubber (EPR) Ring Pack U-Cups
- E. Valves with Stainless Steel plug and seat shall valve stem seals with Spring Loaded Polytetrafluoroethylene (PTFE) and Elastomer V-Rings
- F. Valves with brass trim shall have a maximum leakage specification of 0.01% of maximum flow per ANSI/FCI 70-2, Class 4 and valves with stainless steel trim shall have a maximum leakage of 0.05% of maximum flow
- G. Flow Characteristics shall be equal percentage for two-way valves and linear for three-way valves.
- H. Valves shall be serviceable without being removed from the pipe.
- I. Valves shall be provided with a 3 year warranty.
- J. Valve electric actuators shall be UL-recognized or CSA-certified.

3.6 Globe Valves, Cast Iron, 2-1/2 through 6 in.

- A. Valves shall have bodies manufactured from cast iron.
- B. Valves shall meet the pressure and temperature requirements of ANSI B16.1, Class 125
- C. Valve stems shall be a 316 Series Stainless Steel.
- D. Valves shall have stem seals with Ethylene Propylene Terpolymer (EPT) Ring Pack U-Cups
- E. Valves shall have a maximum leakage specification of 0.1% of maximum flow per ANSI/FCI 70-2, Class 3
- F. Flow Characteristics shall be equal modified linear.
- G. Valves shall be serviceable without being removed from the pipe.

- H. Valves shall be provided with a 3 year warranty.
- I. Valve electric actuators shall be UL-recognized or CSA-certified.

3.7 Electric Zone Valves, 1/2 through 1-1/4 in.

- A. Valves shall have bodies manufactured from Forged Brass.
- B. Valves stems shall be brass (Hard Chrome Plated)
- C. Valve Actuator shall be UL, cUL listed or CSA certified.
- D. Valves shall be rated for service with hot water, chilled water and 50% glycol solutions.
- E. Two Position valves shall have models available rated for use with 15 psig saturated steam.
- F. Valve Actuator shall be replaceable without removing valve from the pipe.
- G. Modulating Valves flow characteristics shall be equal percentage
- H. Valves shall be provided with a 2 year warranty.
- I. Valve actuators shall be UL-recognized or CSA-certified.

3.8 Pressure Independent Valves, 1/2 through 2 in.

- A. Valves bodies shall be manufactured from forged brass and shall be nickel plated
- B. Valves shall have a stem and ball manufactured from chrome plated brass
- C. Valve seat shall be fiberglass reinforced with Teflon®
- D. Characterizing disk shall be brass for 1/2 and 3/4 in. valves, and Tefzel® for sizes 1 through 2 in. valves
- E. Valves shall pressure ratings of 600 psi for 1/2, 3/4 and 1 in. size valves, and pressure rating of 400 psi for 1-1/4, 1-1/2 and 2 in. size valves
- F. Close off Pressure rating shall be 200 psid
- G. Valves shall have a maximum leakage specification of 0.01% of maximum flow per ANSI/FCI 70-2,
- H. Class 4 with a 50 psid differential pressure applied.
- I. Valves shall be maintenance free.
- J. Valves shall be provided with a 5 year warranty.
- K. Valve actuators shall be UL-recognized or CSA-certified.

PART 4 CONTROL DAMPERS

- A. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.
- B. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
- C. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
- D. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
- E. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g.
 - 1. Acceptable manufacturers are Ruskin CD50 or CD60, and Vent Products 5650.
- F. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below.
 - 1. Acceptable manufacturers are: Ruskin CD36, and Vent Products 5800.
- G. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

END OF SECTION

SECTION 230923 – DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 Scope Narrative

- A. Provide controls system, accessible through a modern browser with appropriate IP address and login credentials, to integrate with all mechanical equipment and their associated controllers via BACnet communication protocol. Local hardware shall host graphics, scheduling, alarming, trending, and reporting functions with data storage for 1 year minimum. Provide additional controls sensors for monitoring of points as shown on controls drawings.

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1.3 Related Documents

- A. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 15 Sections for details.
- C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- D. If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

1.4 Definitions

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an “ON” condition is represented by one discrete signal level and an “OFF” condition is represented by a second discrete signal level.
- C. Building Management System (BMS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BMS Contractor and to be interfaced to the associated work of other related trades.
- D. BMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BMS work.
- E. Control Sequence: A BMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.

- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. BMS Network: The total digital on-line real-time interconnected configuration of BMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the BMS network.
- I. BMS Integration: The complete functional and operational interconnection and interfacing of all BMS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BMS as required by this Division.
- J. Provide: The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- K. PC: Personal Computer from a recognized major manufacturer
- L. Furnish: The term “Furnish” and its derivatives when used in this Division shall mean supply at the BMS Contractor’s cost to the designated third-party trade contractor for installation. BMS Contractor shall connect furnished items to the BMS, calibrate, test, commission, warrant and document.
- M. Wiring: The term “Wiring” and its derivatives when used in this Division shall mean provide the BMS wiring and terminations.
- N. Install: The term “Install” and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- O. Protocol: The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BMS network nodes.
- P. Software: The term “software” and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BMS industry for real-time, on-line, integrated BMS configurations.
- Q. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- R. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
- S. The following abbreviations and acronyms may be used in describing the work of this Division:

1. ADC - Analog to Digital Converter
2. AHJ - Authority Having Jurisdiction
3. AI - Analog Input
4. AN - Application Node
5. ANSI - American National Standards Institute
6. AO - Analog Output
7. ASCII - American Standard Code for Information Interchange
8. ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers
9. AWG - American Wire Gauge
10. BTL - BACnet Testing Laboratories
11. CPU - Central Processing Unit
12. CRT - Cathode Ray Tube
13. DAC - Digital to Analog Converter
14. DDC - Direct Digital Control
15. DI - Digital Input
16. DO - Digital Output
17. EEPROM - Electronically Erasable Programmable Read Only Memory
18. EMI - Electromagnetic Interference
19. FAS - Fire Alarm Detection and Annunciation System
20. GUI - Graphical User Interface
21. HOA - Hand-Off-Auto
22. ID - Identification
23. IEEE - Institute of Electrical and Electronics Engineers
24. I/O - Input/Output
25. IT - Information Technology
26. LAN - Local Area Network

27. LCD	-	Liquid Crystal Display
28. LED	-	Light Emitting Diode
29. MCC	-	Motor Control Center
30. NC	-	Normally Closed
31. NIC	-	Not In Contract
32. NO	-	Normally Open
33. OWS	-	Operator Workstation
34. OAT	-	Outdoor Air Temperature
35. PC	-	Personal Computer
36. RAM	-	Random Access Memory
37. RF	-	Radio Frequency
38. RFI	-	Radio Frequency Interference
39. RH	-	Relative Humidity
40. ROM	-	Read Only Memory
41. RTD	-	Resistance Temperature Device
42. SPDT	-	Single Pole Double Throw
43. SPST	-	Single Pole Single Throw
44. XVGA	-	Extended Video Graphics Adapter
45. TBA	-	To Be Advised
46. TCP/IP	-	Transmission Control Protocol/Internet Protocol
47. TTD	-	Thermistor Temperature Device
48. UPS	-	Uninterruptible Power Supply
49. VAC	-	Volts, Alternating Current
50. VAV	-	Variable Air Volume
51. VDC	-	Volts, Direct Current
52. WAN	-	Wide Area Network

1.5 BMS Description

- A. The Building Management System (BMS) shall be a complete system designed for scalable implementation from small use to large, networked systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.
- B. All components of the BMS that are connected via field bus or IP network, including the BMS server, supervisory controllers, equipment controllers, user interface software, system and controller programming tools and software applications shall be designed, engineered, and tested to work together as a complete building management system.
- C. BMS system architecture shall support integration of third-party devices using industry accepted protocols such as BACnet, LonWorks, and MODBUS.
- D. All points of operator user interface shall be on standard PCs, laptops, or mobile computing platforms such as tablets and smart phones that do not require the purchase of any special software from the BMS manufacturer. The primary point of interface on these devices will be a standard web browser.
- E. Where necessary and as dictated elsewhere in these Specifications, BMS servers shall be used for providing a location for extensive archiving of historical point and alarm and operator transactions. All data stored will be using a standard data base platform: Microsoft SQL Server Express or Microsoft SQL Server as dictated elsewhere in this specification.
- F. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.
- G. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.
- H. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- I. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.
- J. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:

1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Diagnostic monitoring and reporting of BMS functions.
5. Offsite monitoring and management access.
6. Energy management
7. Standard applications for terminal HVAC systems.

1.6 Quality Assurance

A. General

1. The Building Management System Contractor shall be a BMS manufacturer-owned branch office, or an independent controls contractor who is factory trained and authorized by the BMS manufacturer to sell, service and support the Building Management System specified herein.
2. The BMS Contractor shall have a facility within a 40-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis. The BMS Contractor shall have at this facility factory trained, directly employed and full-time technical staff, spare parts inventory, and all necessary test and diagnostic equipment.
3. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BMS business for at least the last five (5) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
4. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems and shall be the manufacturer's latest standard of design at the time of bid.

B. Workplace Safety and Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents.
2. The BMS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and subtrades shall comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the

training required by the OSHA rules that have jurisdiction for at least each topic listed in the Safety Certification Manual.

5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:
 - a) Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
 - b) Manage the financial aspects of the BMS Contract.
 - c) Coordinate as necessary with other trades.
 - d) Be responsible for the work and actions of the BMS workforce on site.

1.7 References

A. All work shall conform to the following Codes and Standards, as applicable:

1. National Electric Code (NEC) and applicable local Electric Code.
2. Underwriters Laboratories (UL) listing and labels.
3. UL 864 UUKL Smoke Control
4. UL 268 Smoke Detectors.
5. UL 916 Energy Management
6. NFPA 70 - National Electrical Code.

7. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
 8. American National Standards Institute (ANSI).
 9. National Electric Manufacturer's Association (NEMA).
 10. American Society of Mechanical Engineers (ASME).
 11. Air Movement and Control Association (AMCA).
 12. Institute of Electrical and Electronic Engineers (IEEE).
 13. American Standard Code for Information Interchange (ASCII).
 14. Electronics Industries Association (EIA).
 15. Occupational Safety and Health Administration (OSHA).
 16. American Society for Testing and Materials (ASTM).
 17. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
 18. Americans Disability Act (ADA)
 19. ANSI/EIA 909.1-A-1999 (LonWorks)
 20. ANSI/ASHRAE Standard 135 (BACnet)
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.8 Submittals

A. Shop Drawings, Product Data, and Samples

1. The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
3. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BMS work.
4. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
5. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.

6. The BMS Contractor shall correct any errors or omissions noted in the first review.
7. At a minimum, submit the following:
 - a) BMS network architecture diagrams including all nodes and interconnections.
 - b) Systems schematics, sequences, and flow diagrams.
 - c) Device schedule listing each BMS server, supervisory controller, equipment controller and any other networked devices in the BMS, including device name, device type, network identifier, and device identifier (address).
 - d) Points schedule listing each point in each of the networked devices listed in the device schedule, including point name, point type, point description, and point identifier (address).
 - e) Samples of Graphic Display screen types and associated menus.
 - f) Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
 - g) Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
 - h) Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address.
 - i) Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
 - j) Details of all BMS interfaces and connections to the work of other trades.
 - k) Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.9 Record Documentation

A. Operation and Maintenance Manuals

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished electronically, and include the following for the BMS provided:
 - a) Table of contents.
 - b) As-built system record drawings. Drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.

- c) Manufacturer's product data sheets or catalog pages for all products including software.
 - d) System Operator's manuals.
 - e) Archive copy of all site-specific databases and sequences.
 - f) BMS network diagrams.
 - g) Interfaces to all third-party products and work by other trades.
2. The Operation and Maintenance Manual shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.
- B. On-Line documentation: After completion of all tests and adjustments the contractor shall provide a copy of all as-built information and product data to be installed on a customer designated computer workstation or server

1.10 Warranty

A. Standard Material and Labor Warranty:

1. Provide a one-year labor and material warranty on the BMS.
2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at no expense to the Owner.
3. Maintenance of computer Software Programs: The BMS Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first-year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by BMS Contractor shall come with a 5 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage. Labor to implement upgrades in years two through five are not included in standard warranty.
4. The Owner shall grant to BMS Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

PART 2 PRODUCTS

2.1 General Description

- A. The BMS shall be a complete system designed for scalable implementation from small stand-alone use to large, networked systems. This functionality shall extend into the equipment rooms. Devices residing on the enterprise IT network shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for

coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

B. The Building Management System shall consist of the following:

1. Programmable equipment controllers, for directly operating and controlling mechanical equipment.
2. Network thermostats, for directly operating and controlling mechanical equipment.
3. Field bus network, for exchanging data between equipment controllers and between equipment controllers and supervisory controllers
4. Supervisory controller(s), for managing networks of equipment controllers and providing supervisory control services
5. Automation network, for exchanging data between supervisory controllers, distributed user interface(s), and BMS server.
6. Distributed user interface(s), for providing operational access to the BMS
7. BMS server (optional), for managing networks of supervisory controllers, equipment controllers and providing additional supervisory control services.
8. Application software, for defining the sequence of operation of the BMS.
9. Other components required for a complete and working BMS, including network processing, data storage and communications equipment.

C. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.

1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
2. The System shall maintain all settings and overrides through a system reboot.
3. The System shall comply with the following International Code Council (ICC) Codes:
 - a) Building Officials and code Administrators International (BOMA) model code
 - b) International Conference of Building Officials (ICBO) model code
 - c) Southern Building Code Congress International (SBCCI) regulations

E. Acceptable Manufacturers:

1. Automated Logic
2. Johnson Controls
3. Engineer Control Solutions

2.2 Programmable equipment controllers

- A. Programmable equipment controllers shall include direct wired input interfaces for monitoring analog and binary signals from field devices.
- B. Programmable equipment controllers shall include direct wired output interfaces for controlling field equipment.
- C. Programmable equipment controllers shall include a BACnet MS/TP, IP or optionally N2Open field bus network interface.
 1. Programmable equipment controllers shall be BACnet Testing Labs (BTL) certified and be marked with the BTL Label.
 2. PROGRAMMABLE equipment controllers shall be tested and certified as a BACnet Application Specific Controller (B-ASC) or as BACnet Advanced Application Controller (B-AAC), to, at a minimum, BACnet Protocol Revision 9.
 3. A BACnet Protocol Implementation Conformance Statement shall be provided for the programmable equipment controllers 10 days prior to bidding.
- D. Programmable equipment controllers shall include an expansion sensor and actuator bus (SA Bus) network interface, for interfacing up to 9 of the following types of devices:
 1. Expansion input/output modules
 2. Network sensors (NS-xxx), of the following types and characteristics:
 - a) Network room temperature and humidity sensor(s)
 - (i) The network room temperature and humidity sensors shall be suitable for mounting in an occupied space.
 - (ii) The network room temperature and humidity sensor(s) shall be available in either surface mount or wall mount packaging.
 - (iii) The network room temperature and humidity sensor(s) shall include either screw terminals or 6-pin RJ-style modular jack for SA Bus wiring connections.
 - (iv) The network room temperature and humidity sensor(s) shall have the ability to monitor the following variables as required by the system's sequence of operations:
 1. Zone temperature
 2. Zone humidity

3. Zone setpoint
 - (v) The network room temperature and humidity sensor(s) shall include the following operator controls:
 1. A backlit Liquid Crystal Display (LCD) to indicate the temperature, humidity and setpoint
 2. An LED to indicate the status of the Override feature
 3. A button to toggle the temperature display between Fahrenheit and Celsius
 4. A button to program the display for temperature or humidity
 5. A button to initiate a timed override command
 6. A dial to change the setpoint or warmer/cooler adjustment.
- b) Network room CO2 sensor(s):
 - (i) The network room CO2 sensor(s) shall be suitable for mounting in an occupied space
 - (ii) The network room CO2 sensor(s) shall be available in either surface mount or wall mount packaging.
 - (iii) The network room CO2 sensor(s) shall include either screw terminals or 6-pin RJ-style modular jack for SA Bus wiring connections.
 - (iv) The network room CO2 sensor(s) measurement range shall be 0-2,000 ppm.
- c) Network discharge air temperature sensor(s):
 - (i) The network discharge air temperature sensor(s) shall be suitable for mounting in supply or discharge air duct.
 - (ii) The network discharge air temperature sensor(s) shall include a 4 inch or 8 inch duct insertion probe.
 - (iii) The network discharge air temperature sensor(s) shall include 10 foot pigtail type wiring lead.
- d) The network sensor(s) shall transmit the information back to the controller on the sensor-actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
 - (i) The network sensor(s) shall be BACnet Testing Labs (BTL) certified and be marked with the BTL label.
 - (ii) The network sensor(s) shall be tested and certified as a BACnet Smart Sensors (B-SS).

- (iii) A BACnet Protocol Implementation Conformance Statement shall be provided for the network sensor(s).
 - (iv) The Conformance Statement shall be submitted 10 days prior to bidding.
3. Variable speed drive(s)
 4. Local display/keypad with the following characteristics:
 - a) The local display/keypad shall allow the user to view monitored points without logging into the system.
 - b) The local display/keypad shall allow the user to view and change setpoints, modes of operation, and parameters.
 - c) The local display/keypad shall provide password protection with user adjustable password timeout.
 - d) The local display/keypad shall be menu driven with separate paths for:
 - (i) Input/Output
 - (ii) Parameter/Setpoint
 - (iii) Overrides
 - e) The local display/keypad shall use easy-to-read English text messages.
 - f) The local display/keypad shall allow the user to select the points to be shown and in what order.
 - g) The local display/keypad shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightens and automatic backlight brightening during user interaction.
 - h) The local display/keypad shall be a minimum of 4 lines and a minimum of 20 characters per line
 - i) The local display/keypad shall have a keypad with no more than 6 keys.
 - j) The local display/keypad shall be panel mountable.
 5. Air balancing tool
 6. One-to-one wireless room sensor receiver with the following capabilities:
 - a) The one-to-one wireless room sensor receiver shall receive wireless radio frequency (RF) signals containing temperature, humidity and occupancy data from multiple wireless room sensors and communicate this information to programmable equipment controllers via the Sensor Actuator (SA) Bus.

- b) The one-to-one wireless room sensor receiver shall use direct sequence spread spectrum RF technology.
- c) The one-to-one wireless room sensor receiver shall operate on the 2.4 GHZ ISM Band.
- d) The one-to-one wireless room sensor receiver shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
- e) The one-to-one wireless room sensor receiver shall be FCC compliant to CFR Part 15 subpart B Class A.
- f) The one-to-one wireless room sensor receiver shall operate as a bidirectional transceiver with the sensors to confirm and synchronize data transmission.
- g) The one-to-one wireless room sensor receiver shall be capable of communication with from one to five wireless room sensors up to 200 Feet.
- h) The one-to-one wireless room sensor receiver shall be assembled in a plenum rated plastic housing with flammability rated to UL94-5VB.
- i) The one-to-one wireless room sensor receiver shall have LED indicators to provide information regarding the following conditions:
 - (i) Power
 - (ii) SA Bus - Receiver Activity/No Activity
 - (iii) Wireless RF - Transmission from sensors/No Transmission
 - (iv) Wireless Rapid Transmit Mode - No transmission/ weak signal/Adequate signal/Excellent signal
- j) The one-to-one wireless room sensor receiver shall receive room temperature, humidity, and occupied information from the wireless room sensors, which shall include the following capabilities:
- k) The wireless room sensors shall use direct sequence spread spectrum RF technology.
- l) The wireless room sensors shall operate on the 2.4 GHZ ISM Band.
- m) The wireless room sensors shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
- n) The wireless room sensors shall be FCC compliant to CFR Part 15 subpart B Class A.
- o) The wireless room sensors shall be available with:
 - (i) Warmer/Cooler Set Point Adjustment
 - (ii) No Set Point Adjustment

(iii) Set Point Adjustment Scale - 55 to 85° F.

- p) The wireless room sensors shall be assembled in NEMA 1 plastic housings.
- E. Programmable equipment controllers shall have the capability to execute complex control sequences involving direct wired input/output points as well as input and output devices communicating over the FC Bus or the SA Bus.
- F. Programmable equipment controllers shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
- G. Programmable equipment controllers shall employ a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
- H. Programmable control logic shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
- I. Programmable equipment controllers shall be fully programmable and definable using a software tool with the following characteristics:
1. A simple, check-the-box or selection-type wizard method, with selections for the most popular HVAC equipment and control strategy options.
 2. A graphical, functional logic block editor for creating new or editing existing programming logic.
- J. Programmable equipment controllers shall provide the ability to be downloaded and uploaded either locally or using the communications network. Programmable equipment controllers shall support being loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.
- K. Control setpoint changes initiated over the network shall be written to programmable equipment controllers' non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
- L. Programmable equipment controllers' firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
- M. Programmable equipment controllers shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB or the controller is designed and suitable for use in other environmental air space (plenums) in accordance with Section 300.252(C) of the National Electrical Code.
- N. The programmable equipment controllers shall include troubleshooting LED indicators to identify the following conditions:
1. Power On

2. Power Off
 3. Download or Startup in progress, not ready for normal operation
 4. No Faults
 5. Device Fault
 6. Field Controller Bus - Normal Data Transmission
 7. Field Controller Bus - No Data Transmission
 8. Field Controller Bus - No Communication
 9. Sensor-Actuator Bus - Normal Data Transmission
 10. Sensor-Actuator Bus - No Data Transmission
 11. Sensor-Actuator Bus - No Communication
- O. Models of programmable equipment controllers dedicated to controlling variable air volume (VAV) boxes shall be provided with the following characteristics:
1. The programmable VAV box controller shall provide both standalone and networked direct digital control of pressure-independent or pressure-dependent variable air volume terminal units, for either single or dual duct applications.
 2. The programmable VAV box controller shall include an integrated differential pressure transducer and VAV box damper actuator, all connected and housed as a single assembly that can be mounted and removed as one piece.
 3. The integral VAV box damper actuator shall be a 4 Nm, non-spring return, fast-response actuator capable of stroking 90 degrees in 60 seconds for quick damper positioning to expedite commissioning and troubleshooting tasks.
 4. The programmable VAV box controller shall measure airflow using an integrated, digital, non-flow pressure sensor providing 14-bit resolution with bidirectional flow operation that supports automatic correction for polarity on high- and low-pressure DP tube connections to eliminate high- and low-pressure connection mistakes.
 5. The programmable VAV box controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
 6. The programmable VAV box controller shall include input interface(s) to monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
 - a) 0-10 VDC sensors
 - b) 0-2k ohm resistive temperature detector (RTDs)

- c) 10k Type L and 2.252k type 2 NTC thermistors
- 7. The programmable VAV box controller shall include input interface(s) to monitor dry contact closures, with filtering to eliminate false signals resulting from input "bouncing".
- 8. The programmable VAV box controller input interfaces shall be internally isolated from power, communications, and output circuits, for noise immunity.
- 9. The programmable VAV box controller shall include output interface(s) with the following characteristics:
 - a) 0-10 VDC analog output
 - b) SPST triac output rated for 500mA at 24 VAC.
- 10. The programmable VAV box controller's output interfaces shall be internally isolated from power, communications, and other output circuits for noise immunity.
- 11. The programmable VAV box controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle, to reduce commissioning costs, and to eliminate the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.
- 12. The programmable VAV box controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
- 13. The programmable VAV box controller shall interface with air balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.
- 14. The programmable VAV box controller shall have on-board diagnostics, including control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The programmable VAV box controller shall calculate exponentially weighted moving averages (EWMA) for each of the following, and these metrics shall be available to the end user for efficient management of the VAV terminals.
 - a) Absolute temperature loop error
 - b) Signed temperature loop error
 - c) Absolute airflow loop error
 - d) Signed airflow loop error
 - e) Average damper actuator duty cycle
- 15. The programmable VAV box controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall include:
 - a) Unreliable space temperature sensor

- b) Unreliable differential pressure sensor
 - c) Starved box
 - d) Actuator stall
 - e) Insufficient cooling
 - f) Insufficient heating
16. The programmable VAV box controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The programmable VAV box controller would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.
17. The programmable VAV box controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality) and shall be capable of resetting the box minimum airflow based on the percent of outdoor air in the primary air stream.
18. The programmable VAV box controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.
- P. Models of programmable equipment controllers dedicated for general purpose shall be provided with the following characteristics:
- 1. The general-purpose programmable equipment controllers shall support, but not be limited to, the following applications:
 - a) Terminal units
 - b) Packaged rooftop units and heat pumps
 - c) Built-up air handling units
 - d) Chilled water/central plants
 - e) Heating central plants
 - f) Special applications as required for systems control
 - 2. The general-purpose programmable equipment controllers shall include input interface(s) to monitor the following analog signals, without the addition of equipment outside the controller cabinet:
 - a) 0-10 VDC sensors
 - b) 4-20 mA sensors
 - c) 0-2k ohm resistive temperature detector (RTDs)

- d) 10k Type L and 2.252k type 2 NTC thermistors
3. The general-purpose programmable equipment controllers shall include input interface(s) to monitor the following binary signals:
 - a) Dry contact closures, with filtering to eliminate false signals resulting from input "bouncing".
 - b) Pulse Counter/Accumulator Mode (high speed), 100 Hz
 4. The general-purpose programmable equipment controllers' input interfaces shall be internally isolated from power, communications, and output circuits, for noise immunity.
 5. The general-purpose programmable equipment controllers shall include output interface(s) with the following characteristics:
 - a) 0-10 VDC analog output
 - b) 4-20 mA analog output
 - c) SPST triac output rated for 500mA at 24 VAC.
 6. The general-purpose programmable equipment controllers' output interfaces shall be internally isolated from power, communications, and other output circuits for noise immunity.
 7. The general-purpose programmable equipment controllers shall support an optional, display/keypad integrated into the controller's housing face, with the following characteristics:
 - a) The integrated display/keypad shall allow the user to view monitored points without logging into the system.
 - b) The integrated display/keypad shall allow the user to view and change setpoints, modes of operation, and parameters.
 - c) The integrated display/keypad shall provide password protection with user adjustable password timeout.
 - d) The integrated display/keypad shall be menu driven with separate paths for:
 - e) Input/Output
 - f) Parameter/Setpoint
 - g) Overrides
 - h) The integrated display/keypad shall use easy-to-read English text messages.
 - i) The integrated display/keypad shall allow the user to select the points to be shown and in what order.

- j) The integrated display/keypad shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightness and automatic backlight brightening during user interaction.
 - k) The integrated display/keypad shall be a minimum of 4 lines and a minimum of 20 characters per line.
 - l) The integrated display/keypad shall have a keypad with no more than 6 keys.
- Q. Models of programmable equipment controllers dedicated for advanced control applications shall be provided with the following characteristics:
- 1. The advanced application equipment controllers shall support, but not be limited to, the following applications:
 - a) Packaged rooftop units and heat pumps
 - b) Built-up air handling units
 - c) Chilled water/central plants
 - d) Heating central plants
 - e) Special applications as required for systems control
 - f) Chilled water/central plant optimization applications including but not limited to:
 - (i) Selection and sequencing of up to eight chillers of different sizes
 - (ii) Selection and sequencing of up to eight (each) primary and secondary chilled water pumps of varying pumping capacities
 - (iii) Selection and sequencing of up to eight condenser water pumps
 - (iv) Selection and sequencing of cooling towers and bypass valve, including single speed, multi-speed, and Vernier control
 - (v) Selection and sequencing of up to four heat exchangers, of different capacities
 - (vi) A proven and documented central cooling plant optimization program that incorporates custom equipment efficiency profiles, without rewriting software code, in order to meet the building load using the least amount of energy as calculated.
 - (vii) The use of advanced control algorithms that apply equipment specific parameters, including operational limits and efficiency profiles, in order to determine equipment start and runtime preferences
 - (viii) Identification of the most efficient equipment combination and automatic control of state and speed of all necessary equipment to balance runtime, optimize timing and sequencing and ensure the efficiency and stability of the central cooling plant

- g) Equipment not using a networked supervisory controller or where it is preferred the scheduling, alarming, and/or trending performed locally in the equipment controllers.
2. The advanced application equipment controllers shall include an integral real-time clock which enables them to locally provide the following time-based application services:
 - a) Scheduling
 - b) Alarming
 - c) Trending
3. The advanced application equipment controllers shall continue time-based monitoring when offline from a supervisory controller for extended periods of time.
4. The advanced application equipment controllers shall include input interface(s) to monitor the following analog signals, without the addition of equipment outside the controller cabinet:
 - a) 0-10 VDC sensors
 - b) 4-20 mA sensors
 - c) 0-2k ohm resistive temperature detector (RTDs)
 - d) 10k Type L and 2.252k type 2 NTC thermistors
5. The advanced application equipment controllers shall include input interface(s) to monitor the following binary signals:
 - a) Dry contact closures, with filtering to eliminate false signals resulting from input "bouncing".
 - b) Pulse Counter/Accumulator Mode (high speed), 100 Hz
6. The advanced application equipment controllers shall be internally isolated from power, communications, and output circuits, for noise immunity.
7. The advanced application equipment controllers shall include output interface(s) with the following characteristics:
 - a) 0-10 VDC analog output
 - b) 4-20 mA analog output
 - c) SPST triac output rated for 500mA at 24 VAC.
 - d) SPST relay outputs
 - e) SPDT relay outputs
8. The advanced application equipment controllers' output interfaces shall be internally isolated from power, communications, and other output circuits for noise immunity.

2.3 Network Thermostats

- A. The network thermostat shall be capable of controlling the following applications:
1. Two- or four-pipe fan coils
 2. Cabinet unit heaters
 3. Pressure dependent variable air volume box
 4. Zoning systems employing reheat including local hydronic reheat valves, or other similar equipment
 5. Split air or packaged units of the following types
 - a) Cooling only
 - b) Cooling units with gas or electric heat
 - c) Heat pumps
 - d) Units with economizers
- B. The network thermostat shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.
- a) Communications shall be selectable locally at thermostat through the touchscreen display
- C. The network thermostat shall be BACnet Testing Labs (BTL) certified and be marked with the BTL Label.
1. The network thermostat shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 2. A BACnet Protocol Implementation Conformance Statement shall be provided for the network thermostat.
- D. The network thermostat shall include a (minimum) 4.0-inch LED backlit touch screen with the following configurable icons.
1. Home screen configurable icons include
 - a) On/Off icon
 - b) Fan override icon
 - c) Zone temperature icon
 - d) Hold temperature icon
 - e) Zone humidity (on applicable models) icon

- f) Occupancy status (on applicable models) icon
 - g) Temperature setpoint icon
 - h) Alarm icon
 - i) Unit status icon
 - j) Date/Time icon
 - k) Fan override icon
2. Home screen non-configurable icon includes
- a) Menu icon
- E. The network thermostat shall provide the flexibility to support any one of the following inputs:
- 1. Integral indoor air temperature sensor
 - 2. Analog input for remote air temperature sensing that supports the following sensor types
 - a) Nickel
 - b) Platinum
 - c) A99B PENN
 - d) 2.25k ohm NTC
 - e) 10k ohm NTC
 - f) 10k ohm NTC Type 3
 - 3. Universal input that supports the following configurations
 - a) Analog sensor
 - b) Cooling when switch is closed
 - c) Heating when switch is closed
 - 4. Remote indoor air temperature sensor
 - 5. Analog input that supports the following configurations.
 - a) Supply temperature sensor
 - 6. Two configurable binary inputs with the following configurations
 - a) Disabled

- b) Occupancy
 - c) Override
 - d) Remote PIR
 - e) Dirty filter
 - f) Service
 - g) Fan Lock
 - h) Open door
 - i) Open window
- F. The network thermostat shall provide the flexibility to support any one of the following fan outputs:
- 1. Binary start/stop
 - 2. Three speed fan control
 - 3. Proportional speed fan control configurable from 0 to 10V
- G. The network thermostat shall provide 4-digit passcode security
- H. Where required by application and indicated on plans or room schedules provide the network thermostat with an integral Passive Infra-Red (PIR) occupancy sensor models.
- I. Where required by application and indicated on plans or room schedules provide the network thermostat with an integral relative humidity sensor model
- J. The network thermostat shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.
- K. The network thermostat shall have a temperature accuracy of $\pm 0.9^{\circ}\text{F}/\pm 0.5^{\circ}\text{C}$ at $70.0^{\circ}\text{F}/21.0^{\circ}\text{C}$ typical calibrated
- L. The network thermostat shall have a humidity accuracy of $\pm 5\%$ RH from 20 to 80% RH at 50 to 90°F (10 to 32°C)
- M. The network thermostat shall provide user equipment visibility from a mobile device through the Mobil Access Portal (MAP) release 4.0 or later.

2.4 FIELD BUS NETWORK

- A. The field bus network shall support communications and data exchange between the equipment controller(s) and the supervisory controller(s).
- B. The field bus network shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.

- C. The field bus network cabling shall be 22 AWG, stranded, 3-wire twisted, shielded cable.
- D. End of line (EOL) termination shall be used on the two devices located at either end of each field bus network segment.
- E. The field bus network shall support a maximum 3 bus segments.
- F. A field bus network segment shall support a maximum of 32 devices.
- G. The field bus network shall support a maximum of 64 total devices.
- H. Each field bus network segment shall be up to 1,220 m (4,000 ft) in length.
- I. Each field bus network shall be up to 3,660 m (12,000 ft) in length.
- J. End of line (EOL) termination shall be used on the two devices located at either end of each field bus network segment.

2.5 SUPERVISORY CONTROLLER(S)

- A. Supervisory controller(s) shall provide network management services between itself and the equipment controllers which are connected to its communications trunks, between itself and other supervisory controllers, and between itself and any user interface clients that are part of the BMS.
- B. Supervisory controller(s) shall be enabled to support and shall be licensed with the following open protocol drivers (client and server) by default:
 - 1. BACnet
 - 2. LonWorks
 - 3. MODBUS
 - 4. SNMP
 - 5. KNX
- C. Supervisory controller(s) shall perform control and operating strategies for the system based on information from any equipment controller connected to the BMS, including but not limited to the following:
 - 1. Scheduling, including calendar functions
 - 2. Historical data collection, management, and visualization
 - 3. Alarm initiation, routing, and notification
 - 4. Time synchronization
 - 5. Managing the exchange of data between itself and equipment controllers
 - 6. Closed loop control and interlocking

- D. Supervisory controllers shall be capable of peer-to-peer communications with other supervisory controllers and with any user interface client connected to the BMS, whether the user interface client is directly connected, connected via cellular modem or connected via the Intranet or Internet.
- E. The communication protocols utilized for peer-to-peer communications between supervisory controllers shall be Niagara 4 Fox, BACnet TCP/IP or SNMP. Use of a different communication protocol for peer-to-peer communications between supervisory controllers is not allowed.
- F. The supervisory controller(s) shall employ a device count capacity license model that supports expansion capabilities.
- G. The supervisory controller(s) shall provide the following hardware features as a minimum:
 - 1. Two 10/100 Mbps Ethernet ports.
 - 2. Two isolated RS-485 ports with biasing switches.
 - 3. 1 GB RAM
 - 4. 4 GB Flash Total Storage / 2 GB user storage
 - 5. Wi-Fi (Client or WAP)
 - 6. USB flash drive
 - 7. High speed field bus expansion
 - 8. -20-60 degrees C ambient operating temperature
 - 9. Integrated 24 VAC/DC global power supply
 - 10. MicroSD memory card employing Encrypted Safe Boot Technology
- H. The supervisory controller(s) shall include an embedded web server to support standard web browser access via the Intranet/Internet. It shall support a minimum of 10 simultaneous users.
- I. The supervisory controller(s) shall provide alarm generation, storage, routing, management and analysis to data sourced from equipment controllers, network thermostats, and direct field inputs, including the following capabilities:
 - 1. Alarming capability shall support being added to any data point in the supervisory controller's database.
 - 2. User-defined criteria shall be used to define when the point meets an alarm condition (is in an alarmed state), including, but not limited to the following:
 - a) For numeric-type data points: when the data point's value falls outside a user-defined range.

- b) For Boolean or enumerated type data points: when the data point's state matches a user defined alarm state.
 - c) For string-type data points, when the data point's string text includes or excludes a user-defined string text.
 - d) For commanded points, when the data point's actual value does not match its commanded value after an appropriate (user-defined) time delay.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements, including but not limited to:
 - a) To alarm.
 - b) Return to normal.
 - c) To default.
4. Each alarm record shall include at a minimum, the following information:
 - a) Name of source data point
 - b) Time and date of alarm occurrence
 - c) Acknowledge time, date, and user who issued acknowledgement
5. Routing of alarms shall be user-defined, and may include one or more of the following destinations:
 - a) A dynamically-updated alarm console on the distributed user interface screen.
 - b) A bound, animated symbol on the distributed user interface screen.
 - c) Email
 - d) Pagers, using paging services that initiate a page-on receipt of email message.
 - e) SMS text message
 - f) Line printer
 - g) Another supervisory controller or a BMS Server for alarm centralization and/or archival
6. Alarms that have gone unacknowledged by the specified contact for a specified time shall re-routed to the next specified contact.
7. Alarms shall support customized text instructions to be assigned to them, so that any time an alarm is generated, the instructions are included and presented along with the alarm notification to guide the operator on how to recover from the alarm condition.

8. Authorized operators shall be allowed (and optionally required) to add a note to one or more alarm records simultaneously to provide historical context for the event that triggered the alarm.
 9. Authorized operators shall be allowed to acknowledge alarms using the alarm console on the user interface.
 10. Authorized operators shall be allowed to silence the audible alarm sound on the alarm console.
 11. Authorized operators shall be allowed to delete alarm records from the alarm database but only after the alarms have been acknowledged and the source data point is in a normal (no longer in alarm) state.
- J. The supervisory controller(s) shall support the following security functions to prevent unauthorized access:
1. The supervisory controller(s) shall use module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 2. The supervisory controller(s) shall use Role-Based Access Control (RBAC) for managing user roles and permissions.
 3. The supervisory controller(s) shall require strong user passwords.
 4. All data in motion and sensitive data at rest in the supervisory controller(s) shall be encrypted.
 5. The supervisory controller(s) shall support LDAP and Kerberos integration of access management.
- K. The supervisory controller(s) shall support tagging to utilize Search, Hierarchy, and User Permission functionality.
- L. The supervisory controller(s) shall provide scheduling capabilities being added to any writable data point in the supervisory controller's database, sourced from any equipment controllers, network thermostats, and direct field inputs, including the following capabilities:
- M. The supervisory controller(s) shall support scheduling on a weekly and special event basis.
1. Authorized operators shall be allowed to view and adjust the exact start/stop time and dates for the weekly schedule and special events from the user interface.
 2. The supervisory controller(s) shall support sharing schedule configurations with other supervisory controller(s), with the BMS server, and with scheduling-enabled BACnet devices.
- N. The supervisory controller(s) shall support data logging capabilities being added to any data point in the supervisory controller's database, sourced from any equipment controllers, network thermostats, and direct field inputs, including the following capabilities:

1. Data logs shall be organized into ordered collections of timestamped records, herein called histories.
 2. Each history record shall include at a minimum, the following information:
 - a) History name
 - b) Data point value
 - c) Time and date when data point was logged
 3. User-defined criteria shall be used to define when the data point is logged, including, but not limited to the following:
 - a) When the data point's value, state, or string changes by a user-defined amount.
 - b) At a regular, repeating, user-defined time intervals.
 4. The supervisory controller shall support user-specified local storage capacity for the history records. The data logging behavior upon reaching the specified capacity shall be user-selectable from the following options:
 - a) Stop: terminate recording.
 - b) Roll: overwrite older records with newer ones.
 5. Histories shall support being viewed by operators in a table or chart format on the user interface.
 6. The supervisory controller shall support the automatic exporting of one or more histories to the BMS server for long term archival.
- O. The supervisory controller's configuration software shall be embedded into the supervisory controller, enabling an authorized user to access the configuration software using a web browser.
- P. The supervisory controller shall be provided with a 5-year software maintenance license. Labor to implement not included.

2.6 Automation Network

- A. The automation network shall be based on an IT industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
- B. The BMS shall network multiple user interface clients, supervisory controllers, and equipment controllers. Provide BMS server as required for systems operation.
- C. All BMS devices on the automation network shall be capable of operating at a minimum communication speed of 100 Mbps, with full peer-to-peer network communication.
- D. Supervisory controllers and BMS server shall reside on the automation network.

- E. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

2.7 BMS Server

- A. Where necessary and as dictated elsewhere in these Specifications, a BMS Server shall reside on the automation network and be used for:
 - 1. Providing a location for extensive archiving of historical data, alarms, and operator transactions sourced from all supervisory controllers on the automation network.
 - 2. Centralizing the user interface for all supervisory controllers on the automation network.
 - 3. Centralizing the scheduling for all supervisory controllers on the automation network.
- B. The BMS server software shall support being hosted on the following computer platforms:
 - 1. Processor: Intel Xeon CPU E5-2640 x64 (or better)
 - 2. Operating System: Windows 10, 64-bit Windows 8.1 Enterprise, 2012 R2 Standard, RHEL-7.
 - 3. Memory: 1GB minimum, 4 GB or more recommended for larger systems.
 - 4. Hard Drive: 4 GB minimum, more recommended depending on archiving requirements.
 - 5. Display: video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
 - 6. Network Support: Ethernet adapter (10/100 Mb) with RJ-45 connector)
 - 7. Connectivity: Full-time, high speed ISP connection is recommended for remote site access (T1, ADSL, cable modem) and IPv6 compliant.
- C. The BMS server shall include an embedded web server to support standard web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- D. The BMS server shall support the automatic importing of one or more histories from the supervisory controller(s) for long term archival.
- E. The BMS server's configuration software shall be embedded into the BMS server, enabling an authorized user to access the configuration software using a web browser.

2.8 Distributed user interface(s)

- A. The BMS system shall utilize a distributed, HTML5 web browser-based, graphical user interface, served up by the supervisory controller(s) and/or BMS server.
- B. The distributed user interface shall require user login upon launching the web browser and selecting the appropriate domain name or IP address.

1. Login shall require the user to enter username and strong password and be successfully authenticated.
 2. User access and control privileges within the system shall be based on the user's defined role as assigned by the system administrator.
- C. The distributed user interface shall include the following features to allow operators to quickly find information within the system:
1. A home page displaying the following information:
 - a) Image of the building
 - b) Current outside air temperature and humidity, today's weather forecast, and tomorrow's weather forecast.
 - c) Links to devices
 - d) Links to schedules
 - e) Links to point summaries
 2. A navigation tree listing a hierarchy of system components, including devices and data points.
 3. A navigation tree listing a hierarchy of the building's spaces, including any buildings, floors, and rooms, with links to the equipment, devices, and data points serving those spaces.
 4. Graphical, floor plan view of the building's spaces, embedded with dynamic links to the views of the equipment, devices, and data points serving those spaces.
- D. The distributed user interface shall provide authorized operators with the following information about each data point in the system database:
1. Identification
 2. Present value
 3. Status, including normal, overridden, offline, and in alarm.
- E. The distributed user interface shall provide authorized operators a check-the-box method to add alarm, trend, and totalization extensions to any data point in the system.
- F. The distributed user interface shall include the following point summaries to allow operators to quickly view data points that share certain attributes:
1. All point summary
 2. Points-in-alarm summary
 3. Points-in-override summary

4. Points-offline summary
 5. Non-normal points summary
- G. The distributed user interface shall allow authorized operators to manually command writable data points in the system as part of a 16-level priority write method, defined as:
1. 1-Emergency/Life Safety Manual Command
 2. 2-Automatic Life Safety
 3. 3-User Defined
 4. 4-User Defined
 5. 5-Critical Equipment Control
 6. 6-Minimum On/Off
 7. 7-User Defined
 8. 8-Override (Manual Operator Command)
 9. 9-Demand Limiting
 10. 10-User Defined
 11. 11-Temperature Override
 12. 12-Stop Optimization
 13. 13-Start Optimization
 14. 14-Duty Cycling
 15. 15-Outside Air Optimization
 16. 16-Schedule
- H. The distributed user interface shall allow authorized operators to issue temporary (adjustable time) or permanent manual commands to writable data points in the system.
- I. The distributed user interface shall include an alarm console for authorized users to perform the following alarm management functions:
1. Authorized operators shall be allowed to view all alarms routed to the alarm console, with the following information:
 - a) Time stamp
 - b) Source state

- c) Acknowledge state
 - d) Source
 - e) Alarm class
 - f) Priority
 - g) Message text
2. Authorized operators shall be allowed to apply the following filters to include or exclude alarms shown on the alarm console:
- a) Source state
 - b) Acknowledge state
 - c) Acknowledge required
 - d) Source
 - e) Alarm class
 - f) Priority
 - g) Normal time range
 - h) Acknowledge time range
 - i) User
 - j) Alarm data
 - k) Alarm transition
 - l) Last update time range
3. Authorized operators shall be allowed to acknowledge alarms, either individually or in bulk using the Shift or Ctrl keys.
4. Authorized operators shall be allowed to select an alarm occurrence in the alarm console and link to the view in the system showing the alarm source.
5. Authorized users shall be allowed to add a note to one or more alarm records simultaneously to provide historical context for the event that triggered the alarm.
6. Authorized operators shall be allowed to silence the audible alarm for one or more alarm sources.
- J. The distributed user interface shall include an alarm database maintenance view for authorized users to delete alarm records from the alarm database, but only after the alarms have been acknowledged and the alarm source has returned to a normal (no longer in alarm) state.

- K. The distributed user interface shall include a history chart view for operators to view historical and live data in a chart over time.
 - 1. The distributed user interface shall allow authorized operators to customize the appearance of the history charts in one or more of the following ways:
 - a) Chart type included any one of the following:
 - (i) Line chart
 - (ii) Area chart
 - (iii) Bar chart
 - (iv) Stacked bar chart
 - (v) Discrete line chart
 - (vi) Discrete area chart
 - (vii) Pie chart
 - b) X and Y axis range
 - c) Data, background, and status colors
 - d) Axis orientation
 - e) Data source zooming
 - f) Turning the chart grid on/off
 - g) Data popups
 - 2. The distributed user interface shall allow operators to view multiple data points simultaneously per history chart.
 - 3. The distributed user interface shall provide a “time zone-less” time range configuration so that operators can plot each history chart with reference to its own time zone, resulting in charts that are aligned by local time.
- L. The distributed user interface shall include a history database maintenance view allowing authorized users to delete history records from the history database.
- M. The distributed user interface shall allow authorized operators to export selected histories as either a table of data in a comma separated variable (*.csv) format or as the selected chart view.
- N. The distributed user interface shall allow authorized operators to view, define, and change the normal, regular, and repeating events in the system schedule using a weekly scheduler view.
- O. The distributed user interface shall allow authorized operators to view, define, and change partial day exceptions to the system schedule.

- P. The distributed user interface shall include a calendar view to allow operators to define and change the special events in the system schedule.

2.9 System Tools

A. Supervisory Controller Configuration Tool

1. The supervisory controller configuration tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a supervisory controller or BMS server.
2. The supervisory controller configuration tool shall create a station database for the configuration and application data.
3. The supervisory controller configuration tool shall have the same look-and-feel as the distributed user interface, regardless of whether the configuration is being done online or offline.
4. The supervisory controller configuration tool shall include the following features:
 - a) System component navigation tree for configured networks
 - b) Integration of BACnet, N2, Lonworks, MODBUS, and supported 3rd party integrated devices
 - c) Configuration of customized user navigation trees
 - d) Graphic view design, layout, and data source binding
 - e) Alarm and event configuration
 - f) Historical data management configuration
 - g) Schedule configuration
 - h) Graphical logic connector tool for custom programming
 - i) Copying, transferring, and archiving databases
5. The supervisory controller configuration tool shall have the capability to automatically create the following station components
 - a) Devices
 - b) Points
 - c) Default trend, alarm, and totalization extensions
 - d) Graphic views

B. Programmable Equipment Controller Configuration Tool

1. The programmable equipment controller configuration tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool.
2. The programmable equipment controller configuration tool shall contain a library of designed and tested applications with a check-the-box application option selector.
3. The programmable equipment controller configuration tool shall contain a logic editor to allow creation of new and editing of existing applications.
4. The programmable equipment controller configuration tool shall support running in a Simulation Mode to verify the configuration prior to downloading to a live controller.
5. The programmable equipment controller configuration tool shall support running in a Commissioning mode to verify the configuration while running in a live controller.
6. The programmable equipment controller configuration tool shall support the following connection methods from the PC hosting the tool to the programmable equipment controllers:
 - a) Through a Bluetooth Commissioning Converter
 - b) Through the supervisory controller, when configured for BACnet routing.

2.10 Miscellaneous Devices

A. Local Control Panels

1. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance.
2. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
3. Control panels shall include keyed lock.
4. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
5. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
6. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
7. All wiring shall be neatly installed in plastic trays or tie-wrapped.
8. A 120-volt convenience outlet, fused on/off power switch, and required transformers shall be provided.

B. Power Supplies

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

PART 3 PERFORMANCE/EXECUTION

3.1 BMS Specific Requirements

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

B. Custom Reports:

1. Provide custom reports as required for this project

C. Actuation / Control Type

1. Primary Equipment

- a) Controls shall be provided by equipment manufacturer as specified herein.
- b) All damper and valve actuation shall be electric.

2. Air Handling Equipment

- a) All air handlers shall be controlled with a HVAC-DDC Controller
- b) All damper and valve actuation shall be electric.

3. Terminal Equipment:

- a) Terminal Units (VAV, UV, etc.) shall have electric damper and valve actuation.
- b) All Terminal Units shall be controlled with HVAC-DDC Controller)

3.2 INSTALLATION PRACTICES

A. BMS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.
2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
 - a) All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
 - b) Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BMS Line Voltage Power Source

1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 16.
2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BMS Raceway

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

D. Penetrations

1. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.
2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

E. BMS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
2. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

F. BMS Panel Installation

1. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.

H. HVAC Input Devices – General

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Outside Air Sensors
 - a) Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
 - b) Sensors shall be installed with a rain proof, perforated cover.
6. Water Differential Pressure Sensors
 - a) Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b) Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c) The transmitters shall be installed in an accessible location wherever possible.
7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
 - a) Air bleed units, bypass valves and compression fittings shall be provided.
8. Building Differential Air Pressure Applications (-1" to +1" w.c.):
 - a) Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - b) The interior tip shall be inconspicuous and located as shown on the drawings.
9. Air Flow Measuring Stations:
 - a) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
 - b) Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
10. Duct Temperature Sensors:
 - a) Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.

- b) The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c) For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d) The sensor shall be mounted to suitable supports using factory approved element holders.
11. Space Sensors:
- a) Shall be mounted per ADA requirements.
 - b) Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
12. Low Temperature Limit Switches:
- a) Install on the discharge side of the first water or steam coil in the air stream.
 - b) Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
 - c) For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
13. Air Differential Pressure Status Switches:
- a) Install with static pressure tips, tubing, fittings, and air filter.
14. Water Differential Pressure Status Switches:
- a) Install with shut off valves for isolation.
15. HVAC Output Devices
16. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
17. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
18. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
19. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.

20. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.3 Training

- A. The BMS contractor shall provide the following training services:
 1. One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

3.4 COMMISSIONING

- A. Fully commission all aspects of the Building Management System work.
- B. Acceptance Check Sheet
 1. Prepare a check sheet that includes all points for all functions of the BMS as indicated on the point list included in this specification.
 2. Submit the check sheet to the Engineer for approval
 3. The Engineer will use the check sheet as the basis for acceptance with the BMS Contractor.
- C. VAV box performance verification and documentation:
 1. The BMS Contractor shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
 2. The BMS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance.
- D. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

END OF SECTION

SECTION 232300 – REFRIGERANT PIPING

PART 1 GENERAL

1. This section includes all pipe, pipe fittings, hangers and supports, etc., as may be required to provide a complete refrigerant piping system.
2. Testing of all piping shall be made in the presence of the Engineer or a designated representative of the Owner. No piping shall be covered or put into operation before such testing has been approved.
3. The actual arrangement of the piping shall follow the general locations shown on the drawings such that clearances, line drainage, etc. shall be maintained.

PART 2 PRODUCT

1. Piping
 - a) Refrigerant piping shall be Type "ACR" hard drawn copper conforming to ANSI B-31.5 or ASTM B280.
 - b) Condensate drain piping shall be Type "L" hard drawn copper conforming to ASTM B-88.
2. Piping Fittings
 - a) Copper pipe fittings shall be wrought metal solder joint type and brazed conforming to ANSI B16.22.

PART 3 EXECUTION

1. Piping
 - a) The installation of piping and related items shall be made neatly and in such a manner as not to interfere with access to valves or equipment. Expansion, drainage and maintenance of installed piping shall be possible.
 - b) All piping shall be reamed to remove all burrs, fins and foreign material. Pipe shall be thoroughly cleaned before soldering.
 - c) "Sil-Fos" or silver solder shall be used with non-corrosive flux. During the soldering operation, the pipe shall be purged with nitrogen.
 - d) Sleeves shall be provided wherever pipes pass through walls, floors and ceilings. Sleeves shall be Schedule 40, black steel, one-half inch in diameter larger than the pipe or insulation on the pipe. Sleeves through walls and ceilings shall be flush. Sleeves through floors shall extend one inch above finished floor. Sleeves through exterior walls shall be caulked and made watertight.
2. Hangers and Supports

- a) The spacing of hangers and supports shall not exceed five feet.
 - b) Pipe covering protection saddles shall be used at all supports for insulated piping. Sheet metal shields shall be 10 gauge, three times the diameter of the pipe and minimum of twelve inches long.
3. Testing
- a) All refrigerant equipment not tested at the factory shall be shut off from the rest of the system and tested under a vacuum with no evidence of leakage. Piping systems shall be tested after installation, and before any insulation is applied. All controls and other apparatus that may be damaged by the test pressure shall be removed before tests are made.
 - b) Refrigerant lines shall be tested at 150 psi on low side and at 300 psi on high side per ASA Standard B9.1. System shall be tested with an inert gas of dry nitrogen or dry carbon dioxide. Pressure limiting or pressure reducing valves and gauges on outlet side of tanks shall be used to reduce the tank pressure of the inert gas to the pressure specified above. Pressure shall be maintained for 30 minutes without loss of pressure. If loss of pressure occurs during this time, system shall be checked with halide torch and any leaks repaired. Test shall then be rerun for another 30 minute period. Testing and repair shall continue until there is no loss of pressure. After a satisfactory pressure test, high vacuum pumps (DO NOT USE COMPRESSOR) shall be connected to the system and the system evacuated to a pressure of 0.20 inches of mercury with the system ambient temperature at not less than 36 degrees Fahrenheit. After this has been attained, the vacuum pump shall be valved off from the system for a period of not less than twelve hours. The vacuum shall be broken by charging system with the refrigerant vapor as soon as possible.

END OF SECTION

SECTION 232310 – PIPING SPECIALTIES– REFRIGERATION

PART 1 GENERAL

1. This section includes the expansion valve, solenoid valve, filter drier and miscellaneous items required for a complete refrigeration system.

PART 2 PRODUCT

1. Strainer: Refrigerant strainer shall be T-Type, 80 mesh Monel screen, solder connections, UL Listed, Henry Model 896-S or approved equal by Alco, Cash.
2. Expansion Valve: Expansion valves shall be diaphragm actuated, external equalizer, adjustable, suitable for refrigerant and capacity specified, replaceable thermostatic element, UL listed, soldered connections, Henry 629 Series or approved equal by Alco, Cash.
3. Solenoid Valve: Solenoid valve shall be Series A, soldered connections, suitable for refrigerant and capacity specified, rated for electrical voltage available, UL listed, Henry or approved equal by Alco, Cash. Install in liquid line.
4. Sight Glass: Sight glass shall be single port, soldered connections, positive color contrast, factory assembled, self-contained, removable cap, polished optical glass, protected moisture element, Henry, type M1-30-S or approved equal by Alco, Cash. Line size.
5. Filter Drier: Filter drier shall be factory assembled, sealed, UL listed, suitable for refrigerant and capacity specified, soldered connections, Henry "H" Series, or approved equal by Alco, Cash. One per solenoid valve.

PART 3 EXECUTION

1. All refrigerant piping specialty items shall be installed per manufacturer's recommendations.
2. Gauges or other instruments shall not be installed until piping has been cleaned and tested.

END OF SECTION

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SECTION 233100 – DUCTWORK

PART 1 GENERAL

1.1 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes permitted for job conditions. Size ducts installed in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.2 REFERENCES

- A. NFPA 90A - Installations of Air Conditioning and Ventilating Systems.
- B. SMACNA – HVAC Air Duct Leakage Test Manual.
- C. SMACNA – HVAC Duct Construction Standards – Metal and Flexible.
- D. SMACNA – Fibrous Glass Duct Construction Standards.
- E. UL 181 – Factory-Made Air Ducts and Connectors.

1.3 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, NFPA 96 and SMACNA standards.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants or adhesives when temperatures are less than those recommended by manufacturer.
- B. Maintain temperatures during and after installation of duct sealants.

1.5 SUBMITTALS

A. Product Data:

1. Provide the following information for each sealant system furnished on the Project:
 - a) Sealant name and type.
 - b) Sealant system design pressure.
 - c) Duct material.
 - d) Duct gage.
 - e) Transverse joint methods.
 - f) Longitudinal seam type.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Ducts: ASTM A623 and ASTM A623M galvanized steel sheet, lock-forming quality, having G60 zinc coating in conformance with ASTM A90.
- B. Stainless Steel: ASTM A480, Type 304, sheet form, with No. 1 finish.
- C. Uninsulated Flexible Ducts (Exhaust or Return):
 - 1. Manufacturers: Flexmaster Type NI35.
 - 2. UL-181, Class I: corrosion resistant galvanized steel helix permanently bonded to an impregnated, coated woven fiberglass cover.
 - 3. Pressure rating: 10" positive, 4" negative.
 - 4. Maximum velocity: 5000 fpm.
 - 5. Operating temperature: 0° to 200°F.
- D. Insulated Low Pressure Flexible Ducts:
 - 1. Manufacturer: Flexmaster Type 8M.
 - 2. UL-181, Class I: coated, woven glass fiber mesh liner bonded permanently to corrosion resistant, galvanized steel helix, thick glass fiber insulation and low-perm vapor barriers of glass fiber reinforced metalized laminate with 3 plg standing seam and brass grommets.
 - 3. Pressure rating: 4" positive, 2" negative.
 - 4. Maximum Velocity: 3500 fpm.
 - 5. Operating Temperature: 0° to 180°F
 - 6. Thermal Conductance: 0.23 @ 75°F.
- E. Insulated Medium Pressure Flexible Ducts:
 - 1. Manufacturer: Flexmaster Type 4M.
 - 2. UL-181, Class I: a heavy coated fiberglass cloth locked permanently to a galvanized steel helix, glass fiber insulation with fiberglass scrim on the outside; polyolefin vapor barrier jacket.
 - 3. Pressure rating: 10" positive.
 - 4. Maximum Velocity: 5000 fpm.
 - 5. Operating Temperature: -20° to 200°F
 - 6. Thermal Conductance: 0.23 @ 75°F.

F. Fasteners: Rivets, bolts, or sheet metal screws; stainless steel for stainless steel ductwork.

G. Sealants:

1. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
2. Sealant shall be water based latex UL 181A-M, B-M reinforced sealant conforming to the product specifications.
3. Sealant shall be water based latex UL 181 B-M non-reinforced sealant conforming to the product specifications.
4. All ductwork in a UL classified rolled mastic duct sealant rated tape system shall be comprised of:
 - a) Rolled Mastic Sealant 2 mil foil faced with 15 mils of butyl adhesive/sealant conforming to the product specifications for UL classified sealants
 - b) Rolled Mastic Sealant 2 mil foil faced with 15 mils of modified butyl mastic/sealant meeting UL-181 BFX (pressure sensitive tapes for use with flexible air ducts) for UL listed sealants.

H. Hanger Rod: ASTM A36; steel, threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated. Unless noted otherwise, pressure class shall be determined by fan rating.
- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings two (2) gages heavier than duct gages indicated in SMACNA Standard. Prime coat welded joints with zinc-rich paint.
- E. Provide standard 45 degree lateral wye takeoffs or 90 degree conical tee connections.
- F. Uninsulated panels of ducts over 12 inches wide shall be cross-braced, except plenum casings, which shall be braced with angle iron as called for.
- G. All ductwork must present a smooth interior and joints must be air tight.
- H. Manual volume and splitter dampers to be furnished and installed where shown and where necessary for proper regulation of the air distribution. A quadrant and set screw equal to "Ventlock" #641 shall be installed for all dampers which are accessible.

- I. When the system is in operation, the ductwork shall be free from rattles and air noises caused by unsecure duct construction.
- J. All ductwork, low pressure supply, medium pressure supply, return, exhaust and outside air ductwork shall be constructed to meet SMACNA seal class A.
- K. Refer to section 3.3 for ductwork pressure class schedule.

2.3 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated in paragraph 3.3.
- B. Round or oval ducts upstream of terminal units shall be prefabricated spiral lock seam conduit with fabricated fittings. All ells shall be 5-piece type. Take-offs shall be formed conical “T”, or 45 degree “Y”.
- C. Round Ducts:
 - 1. Manufacturers:
 - a) United Sheet Metal
 - b) Semco
 - c) Hamlin Sheet Metal
 - 2. Machine made from round spiral lockseam duct with reinforcing corrugations; fittings manufactured of at least two (2) gages heavier metal than duct.
- D. Transverse Duct Connection System:
 - 1. Manufacturers:
 - a) Duct Mate
 - 2. SMACNA “E” rated rigid connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.
- E. Double Wall Insulated Duct
 - 1. Insulation (1” thick; refer to Duct Liner Insulation in Section 230700) with solid 20ga. outer liner and 22 ga. inner perforated liner tack welded to support channels. All steel surfaces, channels and trim to be galvanized steel (G-60).
 - 2. Inner liners shall be perforated with 3/32” holes.
 - 3. Each panel shall be completely filled with noncombustible, mildew resistant insulation with flame spread no greater than 25 and smoke development no greater than 50. Thermal conductance no greater than 0.06 at a mean temperature of 75 deg. F.

4. Provide all structural components, beams and columns, necessary to support second level of equipment.
5. Joint construction shall be tongue and groove.

2.4 ACCESS DOORS

- A. All access doors shall close with air pressure. Small doors for access to dampers, etc., shall be 16" x 16" minimum. They need not be hinged, but shall be held in place with sash type locks. They shall have a flanged frame that overlaps liner or insulation.
- B. Ultra-low leakage doors. Nailor Model 0800 Type M1 Double Flange Frame for rectangular duct and Model 0895 for round duct, or equivalent. Knock-over tab frames are not permitted. Maximum leakage must not exceed British Standard DW144 Class A, B, and C.
- C. Provide a safety chain for doors accessed by ladder. Provide grab handles for doors 18" x 10" and larger when there is a positive pressure greater than 3 i.w.c.
- D. Provide long-life closed-cell gaskets.
- E. Provide access door at all locations requiring service access.

2.5 DUCT LINER

- A. "Nosing" sheet metal strip shall be installed on leading edge of all internal duct liner.
- B. See section 230700 Insulation for liner specification.

2.6 DOUBLE WALL PLENUM

- A. Plenum walls and roof shall be constructed of 20 ga. (G60) galvanized interior and exterior skins with 2" 1.5# cu. Ft. density foam insulation set on 4" wide, 4" high concrete curb (2000 psi).
- B. All reinforcing members to be galvanized sized and spaced for 2" negative pressure with T-304 stainless steel fasteners. Maximum deflection shall not exceed 1/200 of any span.
- C. Access door (24"x72) shall be same construction as wall and close with pressure. Access door shall have double gasketed seals around entire perimeter.
- D. Provide two light fixtures (100W ea) with light switch at exterior of access door.
- E. Fastening method to air handler as approved by air handler manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION - DUCTWORK

- A. Install in accordance with manufacturer's instructions.
- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible. It is essential that all air ductwork be practically air tight. Before being insulated or

concealed, all medium pressure air ducts and lab exhaust ducts, including the terminal connections, shall be tested for leakage. Each duct, under an air pressure test shall have no noticeable leaks. The total amount of leakage in the medium pressure supply ductwork of any system shall not exceed 1% of the total cfm of that system as measured by a manometer and a calibrated orifice.

- C. Duct sealant installation shall be in accordance with manufacturer's published recommendations. Allow duct sealant system to cure minimum 48 hours before pressure testing for the fluid applied mastics. Rolled mastic sealants can be tested immediately. All low, medium and high pressure duct systems (positive or negative) shall be pressure tested according to SMACNA test procedures (HVAC Air Duct Leakage Test Manual). Notify Owner minimum seven (7) calendar days in advance of leakage testing.
- D. Duct sizes on plans are inside clear dimensions
- E. 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.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- G. Use double nuts and lock washers on threaded rod supports.
- H. Connect terminal units to supply ducts with maximum length of flexible duct as detailed on plans. Do not use flexible duct to change direction unless shown on drawings.
- I. Connect diffusers to low pressure ducts with maximum length of flexible duct as detailed on plans. Duct to be held in place with strap or clamp.
- J. Connect flexible ducts to metal ducts with adhesive and draw bands. Use sheet metal screws for positive pressure over 2".
- K. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- L. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust or weather from entering ductwork system.
- M. Manufactured casings shall be assembled and installed as noted in paragraph 3.1 A above.

3.2 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean duct in sections of size approved by the Designer. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- B. Clean new plenums and accessible ducts in Mechanical/Equipment Rooms with high power vacuum machines. Clean existing plenums and accessible ducts in Mechanical/Equipment Rooms where indicated with high power vacuum machines. Protect equipment which may be harmed by

excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

3.3 DUCTWORK PRESSURE CLASS SCHEDULE

Air System	Pressure Class Inch
Low Pressure Supply (downstream of terminal units)	2
Medium Pressure Supply (upstream of terminal units)	6
Exhaust Ducts	-3

END OF SECTION

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SECTION 233300 – DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct Silencers (Sound Attenuators)
- B. Air turning devices/extractors.
- C. Backdraft dampers.
- D. Duct test holes.
- E. Flexible duct connections.
- F. Volume control dampers.

1.2 REFERENCES

- A. NFPA 90A - Installation of Air conditioning and Ventilating Systems.
- B. NFPA 92A - Smoke Control Systems.
- C. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- D. UL 33 - Heat Responsive Links for Fire-Protection Service.
- E. UL 555 - Fire Dampers and Ceiling Dampers.
- F. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 DUCT SILENCERS (SOUND ATTENUATORS)

- A. Manufacturers:
 - 1. Vibro-Acoustics
 - 2. Price
 - 3. IAC
- B. Description: low frequency rectangular duct silencer fabricated in accordance with SMACNA HVAC Duct Construction Standards Metal.
- C. Materials:

1. Outer Casing: Minimum 22 gage (0.8 mm) thick galvanized steel stiffened as required, with welded seams.
2. Inner Casing and Splitters: Minimum 26 gage (0.5 mm) thick perforated galvanized steel.
3. Fill: Fiberglass.

2.2 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-Blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with push-pull operator strap. Provide air turning vanes in all supply and return square elbows. Vanes in medium pressure supply duct shall be double wall type.
- B. Steel or fiberglass fixed vanes for 90 deg. Elbows.

2.3 BACKDRAFT DAMPERS

- A. Manufactures:
 1. Ruskin Manufacturing Co.
 2. Arrow
 3. United Emertech
- B. Gravity backdraft dampers furnished with air moving equipment may be air moving equipment manufacturer's standard construction.
- C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: galvanized steel, extruded aluminum, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, and plated steel pivot pin adjustment device to permit setting for varying differential static pressure.

2.4 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.5 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA Medium Pressure Duct Construction Standards, and as indicated.
- B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz. per sq. yd., approximately 2 inches wide, crimped into metal edging strip.

2.6 VOLUME CONTROL DAMPERS

- A. Manufactures:
 - 1. Ruskin Manufacturing Co.
 - 2. Arrow
 - 3. United Emertech
- B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- C. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and tow gages heavier for sizes over 24 inches.
- D. Fabricate splitter of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
- E. Fabricate single blade dampers for duct sizes to 12 x 48 inch.
- F. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 122 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- G. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- H. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
- I. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- D. Provide duct test holes where indicated and required for testing and balancing purposes. Neoprene plugs.

- E. Install automatic dampers in manner directed by Temperature Control Sub-Contractor.
- F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- G. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 233400 – POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Inline Centrifugal.
- B. Roof Exhausters
- C. Motors and drives.
- D. Fan accessories.

1.2 RELATED SECTIONS

- A. All Sections Apply.

1.3 REFERENCES

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- C. AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes.
- D. AMCA 261 - Directory of Products Licensed to Use the AMCA Certified Ratings Seal.
- E. AMCA 301 Method for Calculating Fan Sound Ratings from Laboratory Test Data.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

1.5 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Protect motors, shafts, and bearings from weather and construction dust.

1.7 EXTRA MATERIALS

- A. Supply two sets of belts for each fan.

PART 2 PRODUCTS

2.1 INLINE CENTRIFUGAL

- A. Impeller: Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans. Motor pulleys shall be adjustable for system balancing. Factory wiring shall be provided from motor to the handy box.
- B. Frame: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on two sides, sealed with closed cell neoprene gasketing. Pivoting motor plate shall utilize threaded L-bolt design for positive belt tensioning. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- C. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a pillow block cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- D. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- E. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- F. Isolators: Provide hanging spring isolators.

2.2 BEARINGS AND DRIVES:

- A. Shafts: Hot rolled steel, ground and polished, with keyway; protectively coated with lubricating oil.
- B. V Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
- C. Belt Guard: Fabricate to SMACNA Standards; of 12 gage, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of lubrication, and use of tachometer with guard in place.
- D. Lubrication: Extend lubrication fittings to outside of casing.

2.3 ACCESSORIES:

- A. Straightening Vanes: Welded steel construction with airfoil vanes and casing flanges, finished to mach casing.

- B. Inlet Screens: Galvanized steel welded grid to fit inlet.
- C. Dampers: Welded steel construction, consisting of two semi circular vanes pivoted on oil retaining bearings in short casing section, finished with one coat enamel.
- D. Access Doors: Shaped to conform to casing with quick opening latches and gaskets.

2.4 ROOF VENTILATORS, SUPPLY AND EXHAUST

- A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 16 gage aluminum birdscreen; square base to suit roof curb with continuous curb gaskets.
- B. Roof Curb: 16 inch high self flashing of aluminum with continuously welded seams, built in cant strips one inch insulation, and factory installed nailer strip.
- C. Electrical Characteristics and Components, Single Phase Motors.
 - 1. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
 - 2. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and solid state speed controller.
- D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with nylon bearings.
- E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position.
- F. Fan shaft with self aligning pre-lubricated ball bearings.

2.5 HIGH PLUME DILUTION LABORATORY EXHAUST SYSTEM

- A. Manufacturers:
 - 1. Acceptable Manufacturers:
 - a) Greenheck.
 - b) Cook.
 - c) Twin City.
- B. Corrosion Resistant Coating
 - 1. All fan and system components (fan, nozzle, wind band, plenum) shall be corrosion resistant coated with a two-part electrostatically applied and baked, sustainable, corrosion resistant coating system; or Heresite P-413C.
 - 2. The coating system shall not be less than a total thickness of 6 mils, is not affected by the UV

component of sunlight (does not chalk), and has superior corrosion resistance to acid, alkali, and solvents. Coating system shall exceed 4000-hour ASTM B117 Salt Spray Resistance.

C. Fan Housing Outlet

1. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
2. Fan housing shall be centrifugal involute scroll, allowing all drive components including the motor to be serviced without contact of the contaminated air stream, and manufactured of welded steel coated with a minimum of 4 mils of chemically resistant Hi-Pro Polyester resin, electrostatically applied and baked. Finish color shall be gray. No uncoated metal fan parts exposed to the exhaust will be acceptable/
3. Fan housings that are fabricated of polypropylene or fiberglass that have lower mechanical properties than steel, have rough interior surfaces in which corrosive, hazardous compounds can collect, and / or which chalk and structurally degrade due to the UV component of the sunlight shall not be acceptable.
4. An air induction discharge nozzle shall be supplied by the fan manufacturer and be designed to efficiently handle an outlet velocity of up to 7000 FPM. The nozzle shall induce ambient air up to 270% of the fan capacity. Nozzle / Wind band assemblies fabricated of plastic or resins, having mechanical properties less than steel shall not be acceptable.
5. An integral fan housing drain shall be used to drain rainwater when the fan is de-energized.
6. A bolted housing access door shall be supplied for impeller inspection.
7. Fan assembly shall be AMCA type C spark resistant construction minimum or as noted on the schedule.

D. Fan Impeller

1. Fan impeller shall be centrifugal, single width single inlet, backward inclined airfoil blade design with non-stall characteristics. The impeller shall be electronically balanced both statically and dynamically exceeding AMCA Standards.
2. Fan impeller shall be manufactured of welded and coated steel with a minimum of 4 mils of chemically resistant Hi-Pro Polyester resin, electrostatically applied and baked.
3. Fan impellers that are fabricated of polypropylene or fiberglass that have lower mechanical properties than steel, and lower maximum tip speeds are not acceptable.

E. Bypass Air Plenum

1. For variable volume systems, the fan manufacturer shall provide a bypass air plenum as shown on drawings. The plenum shall be provided with bypass air damper(s) for introducing outside air at roof level upstream of the fan, complete with bypass air rain hood and bird screen.

2. The plenum shall be constructed of welded cold rolled steel and coated with a minimum of 4 mils of Hi-Pro Polyester resin, electrostatically applied and baked. Plenums that are fabricated of plastics or resins that are combustible and have mechanical properties less than steel shall not be acceptable.
3. The bypass air plenum shall be mounted on an insulated curb. A combination integral fan platform / plenum curb shall be provided by the fan manufacturer.
4. Bypass air damper(s) shall be opposed-blade design for airflow control, airfoil design, fabricated of steel for structural rigidity, and coated with a minimum of 4 mils of chemically resistant Hi-Pro Polyester resin, electrostatically applied and baked. Bypass dampers shall have stainless steel damper rods, bearings and jamb seals and the blades shall have polymer edge seals. Dampers shall be suitable for application up to 15 inches wg. Damper blade drive linkage shall be set by manufacturer and welded to eliminate linkage slippage. All damper access and service (drive actuators) shall be performed outside of the contaminated plenum interior.
5. Fan isolation damper(s) shall be parallel-blade design, airfoil design, fabricated of steel for structural rigidity, and coated with a minimum of 4 mils of chemically resistant Hi-Pro Polyester resin, electrostatically applied and baked. Bypass dampers shall have stainless steel damper rods, bearings and jamb seals and the blades shall have polymer edge seals. Dampers shall be suitable for application up to 15 inches wg. Damper blade drive linkage shall be set by manufacturer and welded to eliminate linkage slippage. All damper access and service, (including removal and replacement and drive actuators) shall be performed outside of the contaminated plenum interior.
6. Isolation damper shall include a factory mounted and wired two-position actuator, complete with a mounted and wired step down transformer, wired to the fan disconnect. Transformer shall be mounted in a NEMA 3R panel, minimum, or that shown on the schedule notes.
7. Plenum shall include a removable bypass air weather hood that is properly sized for low inlet velocity of the bypass air, minimizing the possibility of moisture entrainment

F. Fan Motors And Drive

1. Motors shall be premium efficiency, standard NEMA frame, 1800 or 3600 RPM, TEFC with a 1.15 service factor. A factory mounted NEMA 3R disconnect switch, mounted, and wired, shall be provided for each fan.
2. Motor maintenance shall be accomplished without fan impeller removal or requiring maintenance personnel to access the contaminated exhaust components. Belt drive configuration shall be AMCA arrangement 1, 9, or 10. Direct drive arrangement 4, or direct drive arrangements requiring access and handling of hazardous and contaminated fan components for motor replacement are not acceptable.
3. Drive belts and sheaves shall be sized for 200% of the fan operating brake horsepower and shall be readily and easily accessible for service. Drive shall consist of a minimum of two belts under all circumstances.
4. Fan shaft to be 316 stainless steel.

5. Fan shaft bearings shall be Air Handling Quality, ball or roller pillow block type and be sized for an L-10 life of no less than 200,000 hours. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be acceptable.
6. Bearings shall have extended lube lines with Zerk fittings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install fans as indicated. Install with resilient mountings and with flexible electrical leads.
- C. Install flexible connections specified in between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- D. Provide fixed sheaves required for final air balance.
- E. Provide safety screen where inlet or outlet is exposed.
- F. Provide ceiling suspended units with support brackets bolted to casing flange.

END OF SECTION

SECTION 233600 - TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Variable volume supply reheat terminal units.
- B. Integral heating coils.
- C. Integral damper motor operators.
- D. Integral controls.
- E. Laboratory terminal units and Lab Control.

1.2 PERFORMANCE TOLERANCES

- A. Base performance on tests conducted in accordance with ADC 1062.

1.3 OPERATION AND MAINTENANCE DATA

- A. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.5 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Terminal units for spaces other than laboratory spaces:
 - 1. Price.

2. Metal-Aire
3. Nailor Industries
4. Tuttle & Bailey
5. Titus
6. Environmental Technologies, Inc./Johnson Controls, Inc (ETI/JCI)

B. Supply, Return and Exhaust Terminal Units (Valves) for Laboratory:

1. Accutrol
2. Phoenix
3. Price

2.2 MANUFACTURED UNITS

- A. Variable air volume supply air control terminals for connection to single duct, central air systems, with electronic variable volume controls and hot water heating coils.
- B. Variable air volume exhaust air control terminals for connection to single duct, central air systems, with electronic variable volume controls and electric heating coil.
- C. Identify each terminal unit with clearly marked identification label and airflow indicator. Include unit nominal air flow, maximum factory set airflow, minimum factory set air flow, and coil type.

2.3 SINGLE DUCT VARIABLE VOLUME SUPPLY UNITS

A. Basic Assembly:

1. Casings: Minimum 22 gage galvanized steel.
2. Lining: Minimum ½ inch thick foil-faced fibrous glass insulation, 1.5 lb/cu ft density, meeting NFPA 90A requirements and UL 181 erosion requirements.
3. Plenum Air Inlets: Round stub connections for duct attachment.
4. Plenum Air Outlets: S slip and drive connections.
5. Heating Coils: Factory mounted and insulated.

B. Basic Unit:

1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud.
2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings; maximum damper leakage: 2 percent of design air flow at 3 inches rated inlet static pressure.
3. Mount damper operator to position damper normally closed.

C. Hot Water Heating Coil:

1. Construction: 1/2-inch (13 mm) copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 psig (10380 kPa) pressure, factory installed.

D. Automatic Damper Operator:

1. Electric Actuator: 24-volt with high limit Velocity Reset Controller and Probe:
 - a. Electronic.
 - b. Minimum and maximum limits set at reset device.
 - c. Maintain air flow to within 5 percent of set point with inlet static pressure variations up to 2 inches.
 - d. Reset span, adjustable 3 to 8 psi (21-55 kPa) shall remain constant regardless of minimum or maximum setting. Reset start point shall be adjustable from 3-10 psi (21-69 kPa).
 - e. Provide terminal units with insulated access panel.

2.4 LABORATORY VARIABLE VOLUME UNITS (SUPPLY, RETURN, EXHAUST)

A. General:

1. This system shall be provided, installed, and warranted by the Building EMS provider under Section 230923.
2. A laboratory airflow control system shall control the airflow into and out of laboratory rooms. The exhaust flow rate of a laboratory fume hood shall be controlled precisely to maintain a constant average face velocity into the fume hood at either a standard/in-use or standby level based on an operator's presence in front of the fume hood. The laboratory control system shall vary the amount of make-up/supply air into the room to operate the laboratories at the lowest possible airflow rates necessary to maintain temperature control, achieve minimum ventilation rates and maintain laboratory pressurization in relation to adjacent spaces (positive or negative). The laboratory airflow control system shall be capable of operating as a standalone system or as a system integrated with the Building Management System (BMCS).

B. Basic Unit:

1. The valve assembly manufacturer's Quality Management System shall be registered to ISO 9001:2000.
2. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifolded system.
3. The airflow control device shall maintain accuracy within $\pm 5\%$ of signal over an airflow turndown range of no less than 16 to 1.
4. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.
5. The airflow control device shall be constructed of one of the following three types:
 - a. Class A—The airflow control device for non-corrosive airstreams, such as supply and general exhaust, shall be constructed of 16-gauge aluminum. The device's shaft and shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of aluminum. The pressure independent springs shall be a spring-grade stainless steel. All shaft bearing surfaces shall be

- made of a Teflon, polyester, or PPS (polyphenylene sulfide) composite. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24-gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used.
- b. Class B—The airflow control device for corrosive airstreams, such as fume hoods and biosafety cabinets, shall have a baked-on, corrosion-resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring-grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of a Teflon or PPS (polyphenylene sulfide) composite.
6. Actuation: All valve actuation shall be electric, and a UL 916 listed electronic actuator shall be factory mounted to the valve. Loss of main power shall cause the valve to position itself in an appropriate failsafe state. Options for these failsafe states include normally open-maximum position, normally closed-minimum position and last position. This position shall be maintained constantly without external influence, regardless of external conditions on the valve (within product specifications).
 7. There shall be no reliance on external or building-level control devices to perform room-level control functions. Each laboratory control system shall have the capability of performing fume hood control, pressurization control, temperature control, humidity control, and implement occupancy and emergency mode control schemes. The laboratory airflow control systems shall have the option of digital integration with the BMCS.
 8. Certification:
 - a. Each airflow control device shall be factory calibrated to the job specific airflows as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of no more than $\pm 1\%$ of signal over the entire range of measurement. Electronic airflow control devices shall be further calibrated, and their accuracy verified to $\pm 5\%$ of signal at a minimum of 48 different airflows across the full operating range of the device.
 - b. Each airflow control devices shall be marked with device-specific factory calibration data. At a minimum, it should include the tag number, serial number, model number, eight-point characterization information (for electronic devices), and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation.
 - c. Accuracy shall be no less than $\pm 0.15\%$ of span (to equal $\pm 5\%$ of signal with a 15 to one turndown) over the appropriate full-scale range, including the combined effects of nonlinearity, hysteresis, repeatability, drift over a one-year period, and temperature effect. 316L stainless steel materials shall be provided for all exhaust applications. The use of 304 stainless steel materials shall be provided for all make-up air applications.
 - d. Airflow sensors shall be of a multi-point averaging type, aluminum construction for all supply and general exhaust applications, 316L stainless steel for all fume hood, canopy, snorkel, and biosafety cabinet applications. Single point sensors are not acceptable.

C. Fume Hood Control:

1. For variable air volume (VAV) systems, a sash sensor shall be provided to measure the height of each vertically moving fume hood sash. A sash sensor shall also be provided for horizontal overlapping sashes.
2. A presence and motion sensor shall be provided to determine an operator's presence in front of a hood by detecting the presence and/or motion of an operator, and to command the laboratory airflow control system from an in-use operating face velocity (e.g., 100 fpm) to a standby face velocity (e.g., 60 fpm) and vice versa.
 - a. The sensor shall define a detection zone that extends approximately 20" (50 cm) from the front of the fume hood. If the sensor does not detect presence and/or motion in its detection zone within five seconds, it shall command the system to the user-adjustable standby face velocity. When the sensor detects the presence and/or motion of an operator within the detection zone, it shall command the system to the in-use face velocity within one second.
 - b. The sensor shall have a control circuit that adapts to its specific surroundings and adjusts automatically for inanimate objects placed within its detection zone. It shall map the area into memory and, after a period of five minutes, nullify the image of the inanimate object and return to a standby mode. When operators enter and leave the zone, the unit shall adjust automatically between in-use and standby modes. If the inanimate object is moved or taken out of the zone, the unit shall re-map the area automatically.
3. The airflow at the fume hood shall vary in a linear manner between two adjustable minimum and maximum flow set points to maintain a constant face velocity throughout this range. A minimum volume flow shall be set to assure flow through the fume hood even with the sash totally closed.

D. Hot Water Heating Coil:

1. Construction: 1/2-inch copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 psig (10380 kPa) pressure, factory installed.
2. Minimum 2 row coil shall be provided.
3. Capacity: Based as indicated in schedules.

E. Sound Control:

1. A silencer or sound attenuator shall be provided for each valve (supply, hood exhaust, and general exhaust) . All silencers must be of a packless design (constructed of at least 18-gauge 316L stainless steel when used with fume hood exhaust) with a maximum pressure drop at the device's maximum rated flow rate not to exceed 0.20 inches of water.
2. All proposed airflow control devices shall include discharge, exhaust and radiated sound power level performance.

F. Exhaust and Supply Airflow Device Controller:

1. The airflow control device shall be a microprocessor-based design and shall use closed loop control to linearly regulate airflow based on a digital control signal. The device shall generate a digital feedback signal that represents its airflow.

2. The airflow control device shall store its control algorithms in non-volatile, re-writeable memory. The device shall be able to stand-alone or to be networked with other room-level digital airflow control devices using an industry standard protocol.
3. Room-level control functions shall be embedded in and carried out by the airflow device controller using distributed control architecture. Critical control functions shall be implemented locally; no room-level controller shall be required.
4. The airflow control device shall use industry standard 24 Vac power.
5. The airflow control device shall have provisions to connect a notebook PC commissioning tool and every node on the network shall be accessible from any point in the system.
6. The airflow control device shall have built-in integral input/output connections that address fume hood control, temperature control, humidity control occupancy control, emergency control, and non-network sensors switches and control devices. At a minimum, the airflow controller shall have:
 - a. Three universal inputs capable of accepting 0 to 10 Vdc, 4 to 20 mA, 0 to 65 K ohms, or Type 2 or Type 3 10 K ohm @ 25-degree C thermistor temperature sensors.
 - b. One digital input capable of accepting a dry contact or logic level signal input.
 - c. Two analog outputs capable of developing either a 0 to 10 Vdc or 4 to 20 mA linear control signal.
 - d. One Form C (SPDT) relay output capable of driving up to 1 A @ 24 Vac/Vdc.
7. The airflow control device shall meet FCC Part 15 Subpart J Class A and be UL916 listed.
8. The airflow control device shall maintain a temperature set point by controlling the airflow and the reheat valve (if required) in response to a room temperature sensor. An additional output shall be provided for supplementary cooling or heating of the office space. If the airflow supply device is not required for make-up airflow control for fume hoods, then the one-second speed of response and fail-safe conditions required of the laboratory airflow control system shall not apply.

G. Control Functions:

1. The airflow control devices shall utilize peer-to-peer, distributed control architecture to perform room-level control functions. Master-slave control schemes shall not be acceptable. Control functions shall include, at a minimum, pressurization, temperature, humidity control, as well as respond to occupancy and emergency control commands.
2. Pressurization Control:
 - a. The laboratory control system shall control supply and auxiliary exhaust airflow devices in order to maintain a volumetric offset (either positive or negative). Offset shall be maintained regardless of any change in flow or static pressure. This offset shall be field adjustable and represents the volume of air, which will enter (or exit) the room from the corridor or adjacent spaces.
 - b. The pressurization control algorithm shall sum the flow values of all supply and exhaust airflow devices and command appropriate controlled devices to new set points to maintain the desired offset. The offset shall be adjustable.
 - c. The pressurization control algorithm shall consider both networked devices, as well as:

- 1) Up to three non-networked devices providing a linear analog flow signal and any number of constant volume devices where the total of supply devices and the total of exhaust devices may be factored into the pressurization control algorithm.
 - d. Volumetric offset shall be the only acceptable means of controlling room pressurization. Systems that rely on differential pressure as a means of control shall provide documentation to demonstrate that space pressurization can be maintained if fume hood sashes are changed at the same time a door to the space is opened.
 - e. The pressurization control algorithm shall support the ability to regulate the distribution of total supply flow across multiple supply airflow control devices in order to optimize air distribution in the space.
3. Temperature Control:
- a. The laboratory control system shall regulate the space temperature through a combination of volumetric thermal override and control of reheat coils and/or auxiliary temperature control devices. The laboratory control system shall support up to four separate temperature zones for each pressurization zone. Each zone shall have provisions for monitoring up to five temperature inputs and calculating a straight-line average to be used for control purposes. Separate cooling and heating set points shall be writeable from the BMS, with the option of a local offset adjustment.
 - b. Temperature control shall be implemented through the use of independent primary cooling and heating control functions, as well as an auxiliary temperature control function, which may be used for either supplemental cooling or heating. Cooling shall be provided as a function of thermal override of conditioned air with both supply and exhaust airflow devices responding simultaneously so as to maintain the desired offset. Heating shall be provided through modulating control of a properly sized reheat coil.
 - c. The laboratory control system shall also provide the built-in capability for being configured for hot deck/cold deck temperature control.
 - d. The auxiliary temperature control function shall offer the option of either heating or cooling mode and to operate as either a standalone temperature control loop or staged to supplement the corresponding primary temperature control loop.
4. Occupancy Control:
- a. The laboratory control system shall have the ability to change the minimum ventilation and/or temperature control set points, based on the occupied state, in order to reduce energy consumption when the space is not occupied. The occupancy state may be set by either the BMS as a scheduled event or through the use of a local occupancy sensor or switch. The laboratory control system shall support a local occupancy override button that allows a user to override the occupancy mode and set the space to occupied for a predetermined interval. The override interval shall be configurable from one to 1440 minutes. The local occupancy sensor/switch or bypass button shall be given priority over a BMS command.

5. Emergency Mode Control:
 - a. The laboratory control system shall provide a means of overriding temperature and pressurization control in response to a command indicating an emergency condition exists, and airflow control devices are to be driven to a specific flow set point. The system shall support up to four emergency control modes. The emergency control modes may be initiated either by a local contact input or BMS command.
 - b. Once an emergency mode is invoked, pressurization and temperature control are overridden for the period that the mode is active. Emergency modes shall have a priority scheme allowing a more critical mode to override a previously set condition.

6. Local Alarm Control:
 - a. The laboratory control system shall provide the means of summing selective alarm activity at the room-level network and generating a local alarm signal. The local alarm signal may be directed to any available output, as well as to the BMS. The alarm mask may be configured differently for each room-level system.

7. Diversity Alarm:
 - a. The laboratory control system shall have the ability of monitoring the airflow values for the pressurized space and generating an alarm signal in the event the total exhaust flow exceeds a predetermined threshold. The diversity alarm is intended to allow the user to take diversity in the design and generate an alarm condition in the event the diversity threshold is compromised. This function must be available in either an integrated or standalone system.

8. Fume Hood Control: Airflow devices intended to control the face velocity of a fume hood shall have the ability to interface directly with the fume hood monitoring device. The airflow control device shall:
 - a. Accept command inputs to regulate the flow accordingly and make this command value available to the BMS.
 - b. Accept a sash position signal and make this value available to the BMS.
 - c. Control device shall be capable of accepting a Usage Based Control signal to indicate user presence and make this signal available to the BMS in the future.
 - d. Provide a flow feedback signal to the fume hood monitor, which may be used for calculating face velocity or to confirm the airflow device has achieved the proper flow rate and make this value available to the BMS.
 - e. Provide alarm signals to the fume hood monitor in the event the airflow device is unable to achieve the proper flow rate, there is a loss of static pressure indicating improper fan operation, or there is a loss of power to the airflow control device, in order to provide a local alarm indication.
 - f. The fume hood airflow control device shall respond to changes in sash position within one second, in order to provide a constant 100-feet-per-minute face velocity when the fume hood is in use.

9. The laboratory control system shall be segregated into subnets to isolate network communications to ensure room-level control functions and BMS communications are carried out reliably. Each laboratory space or pressurization zone shall be its own subnet. Commercially available routers shall be used to provide this isolation.
10. The laboratory airflow control system shall support at least 20 networked devices in each pressurized zone.
11. All points shall be available through the interface to the BMS for trending, archiving, graphics, alarm notification and status reports. Laboratory airflow control system performance (speed, stability and accuracy) shall be unaffected by the quantity of points being monitored, processed or controlled.
12. Refer to the BMS specification for the required input/output summary for the necessary points to be monitored and/or controlled.

H. Interface to Building Management Systems:

1. The supply, general exhaust, and lab hood exhaust controllers shall communicate over the building EMS LON Network without degradation in performance . The controller shall make all points (supply air temp, flow rate, valve position, etc.) available for reading over the Building EMS network on the Building EMS Graphical User Interface. Controllers not capable of communicating in this way will only be allowed if the same information is provided through a gateway provided by the lab controls manufacturer as detailed below:
 - a. The laboratory airflow control system network shall have the capability of digitally interfacing with the BMS. The required software interface drivers shall be developed and housed in a dedicated interface device furnished by the laboratory airflow control system supplier.
 - b. All room-level points shall be available to the BMS for monitoring or trending. The gateway shall maintain a cache of all points to be monitored by the BMS. The room-level airflow control devices shall update this cache continually.

2.5 WIRING

- A. Factory mount and wire VAV terminal unit controls. Mount electrical components in terminal unit control box with removable cover.
- B. Provide industry standard 1/4" male spade connectors on terminal unit controller for field wiring of thermostat, communications and power source.
- C. All wiring shall comply with local and national electric codes and the manufacturer's published installation manual.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide ceiling access doors or locate units above easily removable ceiling components.

- C. Support units individually from structure. Do not support from adjacent ductwork.
- D. Connect to ductwork in accordance with Section 233100.
- E. Verify that electric power is available and of the correct characteristics.

3.2 LABORATORY TERMINAL UNITS

- A. The automatic temperature controls (ATC) contractor shall install the sash sensors, interface boxes, presence and motion sensor, and fume hood monitor on the fume hood under initial supervision of the laboratory airflow control system supplier. Reel-type sash sensors and their stainless-steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels. Sash interface boxes with interface cards shall be mounted in an accessible location.
- B. The ATC contractor shall install all routers and repeaters in an accessible location in or around the designated laboratory room.
- C. The ATC shall install an appropriately sized and fused 24 Vac transformer suitable for NEC Class II wiring and shall extend power wiring to all electric actuators.
- D. All cable shall be furnished and installed by the ATC contractor. The ATC contractor shall terminate and connect all cables as required. The ATC shall utilize cables specifically recommended by the laboratory airflow controls supplier.
- E. The mechanical contractor shall install all airflow control devices in the ductwork and shall connect all airflow control valve linkages.
- F. The mechanical contractor shall provide and install all reheat coils and transitions.
- G. The mechanical contractor shall provide and install insulation as required on coil casings, duct transitions, coil headers.
- H. Each pressurization zone shall have either a dedicated, single-phase primary circuit or a secondary circuit disconnect.

3.3 LABORATORY UNITS AND CONTROLS SYSTEMS START UP AND TRAINING

- A. System start-up shall be provided by a factory-authorized representative of the laboratory airflow control system manufacturer. Start-up shall include calibrating the fume hood monitor and any combination sash sensing equipment, as required. Start-up shall also provide electronic verification of airflow (fume hood exhaust, supply, make-up, general exhaust or return), system programming and integration to BMS (when applicable).
- B. The balancing contractor shall be responsible for final verification and reporting of all airflows.
- C. The laboratory airflow control system supplier shall furnish a minimum of eight hours of owner training by factory trained and certified personnel. The training will provide an overview of the

job specific airflow control components, verification of initial fume hood monitor calibration, general procedures for verifying airflows of air valves and general troubleshooting procedures.

- D. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided for each training attendee.

END OF SECTION 233600

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SECTION 233700 – AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.

1.2 REFERENCES

- A. ARI 650 Air Outlets and Inlets.
- B. ASHRAE 70 Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- C. SMACNA HVAC Duct Construction Standard - Metal and Flexible.

1.3 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

PART 2 PRODUCTS

2.1 SEE PLANS FOR GRILLE AND DIFFUSER SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and structural limitations.
- C. Connect diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, grille or register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

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SECTION 238103 – PACKAGED AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 REFERENCES

- A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. ARI 360 - Unitary Air-Conditioning Equipment.
- C. ANSI/ASHRAE/IESNA 90.1 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.

1.2 SUBMITTALS

- A. Submit drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections.
- B. Submit product data indicating rated capacities, weights, accessories, service clearances and electrical requirements.
- C. Submit manufacturer's installation instructions.

1.3 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, start-up and operating instructions, installation instructions, and maintenance procedures.

1.4 HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.5 WARRANTY

- A. Provide a full parts and labor warranty for one year from final acceptance.
- B. Provide five year extended warranty for compressors including materials and labor.

1.6 REGULATORY REQUIREMENTS

- A. Unit shall conform to UL 1995/CSA 22.2 #236 for construction of packaged air conditioner and shall have UL/CSA label affixed to the unit.

1.7 SUMMARY

- A. The contractor shall furnish and install packaged air conditioning unit(s) as shown and as scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the conditions specified, scheduled or as shown on the contract drawings.

PART 2 PRODUCTS

2.1 GENERAL UNIT DESCRIPTION

- A. Unit(s) furnished and installed shall be a packaged unit as specified on the contract documents and within these specifications. Cooling capacity ratings shall be based upon ARI Standard 360. Unit(s) shall consist of insulated weathertight casing with compressors, air cooled condenser coil, condenser fans, evaporator coil, filters, supply and exhaust fan motors and drives, and unit controls.
- B. Package units shall be constructed for installation on a concrete pad, when installed on the ground, or box curb when installed on a roof. The curb or pad shall provide support as required by the manufacturer's installation instructions.
- C. Unit(s) shall be factory run tested to include the operation of all fans, compressors, heat exchangers, and control sequences.
- D. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. UL Compliance: Comply with UL 1995 Heating and Cooling Equipment
- D. All power wiring to interior devices such as motors, lights, and outlets shall be in conduit. No exposed wires allowed. This requirement is not applicable where unit section is too small for entry.
 - 1. Exception: Use of conduit for power wiring is not required when access doors for the equipment are smaller than 18" x 18". In such case the wiring should be strapped to the equipment housing in a neat, orderly manner and to prevent slippage.
- E. All low voltage wiring to interior devices such as sensors and actuators shall be strapped to the equipment housing in a neat, orderly manner and to prevent slippage.

2.3 UNIT CASING

- A. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating durable enough to withstand a minimum of 500 consecutive-hour salt spray application in accordance with standard ASTM B 117. Structural members shall be heavy gauge with access doors and removable panels of heavy gauge steel. Roof panels shall be sloped to provide positive drainage of rainwater / melting snow away from the cabinet.
- B. Access Doors: Fully gasketed hinged doors with fluted knob fasteners and chained "tie-backs" to provide access to filters, heating section, return/exhaust air fan section, supply air fan section and evaporator coil section.

- C. Control Panel: The unit control panel section shall be compartmented to separate high and low voltage components. The control panels shall also be fully gasketed, hinged and provided with quick release latches for easy access.
- D. Insulation: Provide 2 inch thick foam core injected between sheet metal panels. Insulation value shall be minimum of R9.

2.4 FILTERS

- A. Air Filters: Filters shall mount integral within unit casing and be accessible via hinged access panels. Filter MERV rating shall be as specified on the equipment schedule. One set for each type of filter shall be furnished with air handler and contractor shall furnish an additional set after construction.

2.5 FANS - SUPPLY AND EXHAUST

- A. Dynamically balance all fans and the unit's running fan assembly (fan mounted on actual shaft, bearings and in scroll housing) to assure smooth operation of the fan and its associated assembly. Balancing of the fan only shall not be acceptable.
- B. Mount fan motor(s) and fan on a common base assembly and isolated from unit with 2" deflection spring isolators.
- C. Fan shaft shall be mounted on grease lubricated ball bearings.
- D. Motor shall be open drip-proof. Motor shall have a standard T-frame and a minimum service factor of 1.15. All drive components shall be accessible without the use of scaffolds or ladders, to facilitate periodic maintenance checks and for operator safety.

2.6 EVAPORATOR COIL SECTION

- A. Provide heavy duty aluminum fins mechanically bonded to copper tubes. Evaporator coil shall be inter-circuited to maintain active coil face area at part load conditions. Coil shall also utilize internally enhanced tubing for maximum efficiency.
- B. Provide a thermostatic expansion valve (TXV) for each refrigerant circuit. Factory pressure and leak test coil at 300 psi.
- C. Provide pitched stainless steel drain pan to assure positive drainage of condensate from the unit casing.

2.7 HOT GAS REHEAT SECTION

- A. Provide modulating hot gas reheat coil located on the leaving air side of the evaporator coil. Performance shall be as indicated on the equipment schedule.
- B. Coil shall be pre-piped and circuited with a low pressure switch.

2.8 SCR REHEAT SECTION

- A. Heaters shall be compliant with the National Electric Code and be UL Listed for zero clearance to combustible surfaces and for use with heat pumps and air conditioning equipment.
- B. Heaters shall be fully modulating with SCR control.

- C. Provide with door interlock disconnect switch and automatic reset thermal cutout.
- D. Electric heat capacity shall be as indicated on the equipment schedule.

2.9 CONDENSER SECTION

- A. Provide heavy duty aluminum fins mechanically bonded to copper tubes. Factory leak test coil under 450 psia pressure.
- B. Provide subcooling circuit(s) integral with condenser coils to maximize efficiency and prevent premature flashing of liquid refrigerant, to a gaseous state, ahead of the expansion valve.
- C. Provide vertical discharge, direct drive fans with steel blades, and three phase motors. Fans shall be statically and dynamically balanced. Motors shall be permanently lubricated, with built-in current and thermal overload protection and weathertight slinger over motor bearings.
- D. Furnish unit with factory-installed electronic low ambient option to allow for operation down to 0 degrees F.
- E. Provide factory-installed louvered steel coil guards around perimeter of condensing section to protect the condenser coils, refrigerant piping and control components. Louvered panels shall be fabricated from heavy gauge galvanized steel and be rigid enough to provide permanent protection for shipping and pre-/post- installation. Course wire mesh is not an acceptable material for coil guards.
- F. Condenser coils shall be wrap-around or V-banked. The coils shall not exceed 14 fins per inch density in order to permit routine cleaning and prevent excessive air pressure drop across the condenser coil.

2.10 REFRIGERATION SYSTEM

- A. Compressor: shall be industrial grade, energy efficient direct drive 3600 RPM maximum speed scroll type. The motor shall of a suction gas cooled hermetic design. Compressor shall have centrifugal oil pump with dirt separator, oil sight glass, and oil charging valve. Each compressor shall have a factory installed crank case heater.
- B. Provide with thermostatic motor winding temperature control to protect against excessive motor temperatures resulting from over-/under-voltage or loss of charge. Provide high and low pressure cutouts and reset relay.
- C. Provide factory-installed compressor lockout thermostat to prevent compressor operation at low ambient conditions.
- D. Provide coil frost protection compressor unloading based on refrigerant circuit suction temperature to prevent coil frosting with minimum energy usage. As an alternate, factory-installed hot gas bypass shall be required on all VAV units to prevent coil frosting.
- E. Refrigerant shall be R-410A.

2.11 EXHAUST/RETURN SECTION

- A. Provide 100% modulating exhaust air capabilities for the unit. Unit shall control building pressurization by the operation of exhaust fans and modulation of discharge dampers. Controller

shall compare actual building interior pressure with outside ambient air pressure and supply duct pressure. Pressurization setpoint shall be field adjustable at the human interface to positive, neutral or negative values.

2.12 OUTDOOR AIR SECTION

- A. Provide 100% modulating enthalpy-based economizer system fully integrated with unit return and exhaust air dampers. Unit operation is through primary temperature controls that automatically modulate dampers to maintain desired space temperature conditions.
 - 1. Provide automatic outdoor enthalpy lockout sensor.
- B. Provide adjustable minimum position control through the standard Human Interface.
- C. Provide spring-return motor for outside air damper closure during unit shutdown or power interruption.
- D. Provide an air flow monitoring station to measure and control outside air quantities. The air flow monitoring station shall consist of multi-port sensing tubes across at least 75% of the area at the face of the intake hood or duct to ensure adequate and stable readings. The flow measurements shall be accurate to +/-5% from 100% down to 15% of nominal flow. It shall be also be capable of temperature and altitude compensation correcting for changes in air density.

2.13 DAMPERS

- A. Provide low leak dampers with a leakage rate not to exceed 2.5% of nominal airflow at one inch W.C. static pressure.
- B. Leakage rate shall be determined in accordance with AMCA Standard 575.

2.14 DDC MICROPROCESSOR CONTROLS

- A. General - Each unit shall be provided with a factory-installed, programmed and run-tested, stand-alone, microprocessor control system suitable for VAV control. This system shall consist of temperature and pressure (thermistor and transducer) sensors, printed circuit boards, and a unit-mounted Human Interface Panel. The microprocessor shall be equipped with on-board diagnostics to indicate that all hardware, software, and all interconnected wiring and sensors are in proper operating condition. The microprocessor's memory shall be non-volatile EEPROM type, thus requiring no battery or capacitive backup to maintain all data during a power loss.
- B. The Human Interface Panel shall be readily accessible for service diagnosis and programming without having to open the main control panel on the rooftop unit. Alphanumeric coded displays shall not be acceptable.
 - 1. Human Interface (HI) Panel - shall be a 16 key touch-sensitive membrane key switch panel, password protected to prevent use by unauthorized personnel. The Human Interface Panel display shall consist of a 2 line by 40 characters per line clear english display. The display shall be Supertwist Liquid Crystal Display (LCD) with blue characters, 5 X 7 dot matrix with cursor, on a gray-green background for high visibility and reading ease.
- C. Anti-recycle Protection - shall be provided to prevent excessive cycling, and premature wear, of the compressors, contactors and related components.

- D. Airflow modulation shall be provided by a variable frequency inverter that is factory-mounted and functionally tested. Adjustable frequency inverter drive shall safely vary the speed of the fan motor allowing the motor to meet the dynamic requirements at the shaft of the motor meeting system static. Inverter frequency drive shall match the fan motor according to the motor's FLA rating. Inverter controller shall have a display that provides readout functions that include: output frequency, output voltage, output current, output power, DC bus voltage, interface terminal status, and fault status.
- E. Provide either LON or BACNET BAS interface to front end control panel providing all points indicated on the BAS points list.

2.15 MISCELLANEOUS FEATURES

- A. Remote Set Point: Provide potentiometer for VAV/CV units to allow for remote setting of the discharge air set point based on the outside air temperature, zone average temperature or the position of the dampers in the building's terminal units. Input shall be received from the Building Automation System to reset the discharge air set point.
- B. Horizontal Discharge: Provide field removable access panels to allow for horizontal discharge and return applications.
- C. Provide unit mounted 115 volt convenience outlet

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment pad is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on equipment pad. Install unit level.
- C. If unit is operated during construction, provide minimum of MERV 8 filtration throughout construction up to final turn-over to the Owner. After the unit and system is turned over to the Owner, the contractor shall provide new filters in the unit.
- D. Provide supports for duct mounted exhaust section per manufacturer's recommendations.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer shall provide factory startup and 1st year labor warranty on the entire packaged system.
- B. Instruct operating personnel in operation and maintenance of the unit. Provide a minimum of 8 hours of training in the operation and maintenance of the unit.

END OF SECTION

SECTION 238126 – SPLIT SYSTEM UNITS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Furnish packaged type, indoor, ductless, split condensing DX (single unit systems or variable refrigerant volume systems as indicated in schedule), air handling units of the size, configuration and capacity scheduled on drawings.

1.2 QUALITY ASSURANCE

- A. Certify unit performance in accordance with ARI Standard 210/240.
- B. Furnish units with minimum heating and cooling capacities shown in schedule and on plans.
- C. Provide minimum 1 year complete warranty including parts and service.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Mitsubishi (Basis of Design)
- B. Sanyo
- C. LG
- D. Daikin

2.2 INDOOR UNIT (SINGLE SPLIT SYSTEM)

- A. Performance: See equipment schedule.
- B. Indoor unit shall be wall mounted type, completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an adjustable external static pressure switch.
- C. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
- D. Both refrigerant lines shall be insulated from the outdoor unit.
- E. The indoor units shall be equipped with a return air thermistor.
- F. Switch box shall be reached from the side or bottom for ease of service and maintenance.
- G. Fabricate sheet metal parts of continuous heavy gauge galvanized or phosphatized painted steel. Provide baked enamel finish.

H. Fan:

1. The fan shall be direct-drive type fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The air flow rate shall be available in high and low settings.
3. The fan motor shall be thermally protected.

I. Filter:

1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

J. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3 row cross fin copper evaporator coil with 14 FPI design completely factory tested.
4. The refrigerant connections shall be flare connections.
5. A condensate pan shall be located under the coil.
6. A condensate pump shall be located below the coil in the condensate pan with a built in safety alarm.
7. A thermistor will be located on the liquid and gas line.

2.3 OUTDOOR UNIT (SINGLE SPLIT SYSTEM)

- A. Furnish and install an air-cooled split system outdoor unit, with capacities as indicated on the plans for use with ductless indoor units.
- B. Unit shall be completely factory assembled and pre-tested.
- C. Unit shall be condensing type as noted.
- D. Unit casing shall be galvanized steel, zinc phosphatized, baked enamel finish and fully weatherproof.
- E. Condenser coil shall be of non-ferrous construction, aluminum plate fins, mechanically bonded to seamless copper tube, subcooling circuitry.
- F. Condenser fans and motors shall be direct drive, propeller type fins, Class B motor insulation, inherent protection, permanently lubricated, resiliently mounted; fans shall have safety guard.

- G. Compressor shall be a hermetically sealed, high efficiency compressor with special lubrication system, bearing surfaces and motor installation, internal over-current, over-temperature and over-pressure protection and crankcase heater. The compressors shall have a five (5) year warranty.
- H. A factory provided wire guard shall be provided over the condenser coils for protection from physical damage.
- I. Accessories shall be as indicated on the drawings.

2.4 CONTROLS

- A. General: The control system shall be a neutral color plastic material. Each control shall have a Liquid Crystal Display (LCD)
- B. From each circuit board to the controls, the electrical voltage shall be 16 volts DC.
- C. Wiring: Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit then to the branch selector box and outdoor unit. Control wiring shall run from the indoor unit terminal block to the specific controller for that unit.
- D. Wiring Size: The wire shall be a non-shielded, 2-core sheathed vinyl cord or cable, size AWG18-2.
- E. Individual Zone Controller – Wired Remote Controller
 - 1. The wired remote controller shall be able to control 1 group (maximum of 16 fan coil units) and shall be able to function as follows:
 - a) The controller shall have a maximum wiring length of 1,640 feet.
 - b) The controller shall have a self diagnosis function that constantly monitors the system for malfunctions (total of 80 components).
 - c) The controller shall be able to immediately display fault location and condition.
 - d) An LCD digital display will allow the temperature to be set in 1°F units.
 - e) The controller shall be equipped with a thermostat sensor in the remote controller making possible more comfortable room temperature control.
 - f) The controller shall monitor room temperature and preset temperature by microcomputer and can select cool/heat operation mode automatically
 - g) The controller shall allow the user to select cool / heat / fan operation mode with indoor remote controller of choice without using the cool / heat selector.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install system per manufacturer recommendations and installation instructions.

B. Provide clearance at each unit for routine service.

C. Piping Connections:

1. Support piping independently of coils and with adequate flexibility to prevent undue stress at coil header connections.
2. Install full size drain lines from the drain pan connection and trap to permit condensate to drain freely.
3. Route condensate drain piping as shown on plans.

END OF SECTION

DIVISION 26 ELECTRICAL SPECIFICATIONS
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SECTION 260001 – ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

1.1 DESCRIPTION

- A. It is the intent of this Specification that this Contractor furnish and install all material, labor, equipment, apparatus, tools, transportation, and other incidentals required to provide a complete and operable electrical system which shall include but not be limited to the following: temporary power and lighting, electrical service(s); power distribution (normal and emergency); branch circuit wiring; low voltage wiring; wiring devices; grounding; lighting; lighting control systems; and fire detection and alarm system; and as shown on Drawings and as described in these Specifications.

1.2 REQUIREMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions, General Requirements and other Division 1 specification sections apply to the work specified in this Section.
- B. Provisions of this Section apply to each and every Section of this Division.

1.3 SCOPE

- A. It is the intention of these Specifications and the Contract Drawings to call for finished work, tested and ready for operation.
- B. Any apparatus, appliances, materials, or work not indicated but mentioned in these Specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be furnished, delivered, and installed by this Contractor at no additional expense to the Owner.
- C. Minor details not usually shown or specified, but necessary for the proper installation and operation shall be included the same as if herein specified or shown on the Drawings.
- D. With submission of bid, this Contractor shall give written notice to the Architect/Engineer of any materials or apparatus believed: inadequate or unsuitable; in violation of federal, state, and local laws, codes, and ordinances, and any necessary items of the work which have been omitted. In the absence of such written notice, it shall be mutually agreed that the Contractor has included the cost of all required items in the proposal and that the Contractor shall be responsible for the approved satisfactory functioning of the entire electrical system at no additional expense to the Owner.

1.4 APPLICABLE SPECIFICATIONS, CODES, STANDARDS, AND PERMITS

- A. Materials, equipment, and installation shall be in accordance with the requirements of the National Electrical Code (NEC), all local codes having jurisdiction, and these Specifications.
- B. Unless otherwise specified herein the work and material shall conform to the applicable requirements of the following codes, standards, and regulations:
 - 1. National Electrical Contractors Association (NECA) Standard of Installation.

2. National Electrical Testing Association (NETA) Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 3. National Fire Protection Association (NFPA) NFPA 70 National Electrical Code (NEC). All work shall comply with the NEC.
 4. NFPA 72 – National Fire Alarm Code
 5. Underwriters Laboratories, Inc. (UL).
 6. American with Disability Act – Public Law 101-336 (ADA)
 7. NFPA 101 - Life Safety Code.
 8. NFPA 110 – Standard for Emergency and Standby Power Systems
 9. NFPA 99 - Health Care Facilities.
 10. International Building Code (IBC), 2009.
 11. North Carolina State Building Code
 12. NFPA 13 – Standard for Installation of Sprinkler Systems
 13. NFPA 90A – Standard for Installation of Air Conditioning and Ventilating Systems.
 14. NFPA 92A – Smoke Control Systems
 15. All local codes and adopted amendments to above referenced codes.
- C. All electrical materials and equipment shall be new, listed by UL, and bear the UL label. This applies to all equipment for which UL standards have been established and label service is regularly furnished.
- D. Equipment not UL labeled and equipment assembled in the field using UL components and not UL labeled as an "assembly", for which standards have not been promulgated, shall be accepted upon certification. Cost of such certification shall be included in the base bid and in each quoted cost for alternates and proposed change orders. Electrical equipment that requires certification shall be tested by this Contractor at no additional cost to the Owner.
- E. This Contractor shall: give all necessary notices; obtain all permits (including a low voltage wiring permit); pay all government taxes, fees, and other costs, file all necessary plans; prepare all documents; and obtain required certificates of inspection for work and deliver same to the Architect/Engineer before any request for acceptance and final payment for the work.

1.5 DEFINITIONS

- A. Furnish - Except as otherwise defined in greater detail, the term “furnish: is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations” as applicable to each instance.
- B. Install - Except as otherwise defined in greater detail the term “install” is used to describe operations at the project site including actual “unloading, unpacking, assembly, erection, placing, anchoring, connecting, applying, working to dimension, finishing curing, protecting, testing to

demonstrate satisfactory operation, cleaning and similar operations” as applicable in each instance.

- C. Provide - Except as otherwise defined in greater detail, the term “provide” means to furnish and install, complete and ready for intended use and successfully tested to demonstrate satisfactory operation as applicable in each instance.
- D. Remove - Except as otherwise defined in greater detail, the term “remove” means to disassemble, dismantle, and/or cut into pieces in order to remove the equipment from the site and to properly dispose of the removed equipment and pay for all associated costs incurred.
- E. Replace - Except as otherwise defined in greater detail, the term “replace” means to remove the existing equipment and to provide new equipment of the same size, capacity, electrical characteristics, function etc. as the existing equipment.
- F. Shall - Shall indicates action which is mandatory on the part of the Contractor.
- G. Indicated - The term “indicated” is a cross-reference to graphic representations, details, notes or schedules on the drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as “shown”, “noted”, “scheduled” and “specified” are used in lieu of “indicated” it is for the purpose of helping the reader locate the cross-reference, and no limitation is intended except as specifically noted.
- H. Shown - the term “shown” is a cross-reference to graphic representations, details, notes or schedules on the Contract Drawings and to similar means of recording requirements in the Contract Documents.
- I. Specified - The Term “specified” is a cross-reference to paragraphs or schedules in the specifications and to similar means of recording requirements in the Contract Documents. The specifications include the General Provisions, Special Provisions and the Technical Specifications for the project.
- J. No Exception Taken - Where used in conjunction with the Engineer’s response to submittals, requests, applications, inquiries, reports and claims by the contractor the meaning of the term “no exception taken” shall be held to the limitations of the Engineer’s responsibilities to fulfill requirements of the Contract Documents. The term “no exception taken” shall also mean to permit the use of material, equipment or methods conditional upon compliance with the Contract Documents.
- K. Similar - the term “similar” shall mean generally the same but not necessarily identical; details shall be worked out in relation to other parts of the work.
- L. Submit - the term “submit” shall mean, unless otherwise defined in greater detail, transmit to the Engineer for approval, information and record.
- M. Make Corrections Noted - “make corrections noted” shall mean the submittal essentially complies with the contract documents except for a few minor discrepancies that have been annotated directly on that submittal that will have to be corrected on the submittal and the work correctly installed in the field by the Contractor.

- N. Revise and Resubmit - the term “revise and resubmit” shall mean the Contractor shall revise the submittal to conform with the Contract Documents by correcting moderate errors, omissions and/or deviations from the Contract Documents and resubmit it for review prior to approval and before any material and/or equipment can be fabricated, purchased or installed by the Contractor.
- O. Rejected - The terms “disapproved” or “rejected” shall mean the Contractor shall discard and replace the submittal with a submittal containing the specified items because the submittal contained improper manufacturer, model number, material, etc.
- P. Submit Specified Item - The term “submit specified item” shall mean the Contractor shall discard and replace the submittal with a submittal containing the specified items because the submittal contained improper manufacturer, model number, material, etc.
- Q. Health Care Facilities - Buildings or portions of buildings that contain, but are not limited to, occupancies such as hospitals; nursing homes; limited care; supervisory care; clinics; medical and dental offices; and ambulatory care, whether permanent or movable.

1.6 REVIEWS AND SHOP DRAWINGS

- A. The materials, workmanship, design, and arrangement of all work installed under this contract shall be subject to the review of the Architect/Engineer and Owner.
- B. Where any specified materials, process, or method of construction or manufactured article is specified by name, or by reference to the catalog number of a manufacturer, the specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings.
- C. In all cases, the Contractor shall verify the duty and available electric characteristics with the specific characteristics of the equipment offered for review.
- D. All component parts of each item of equipment or device shall bear the manufacturer's name plate giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc., in order to facilitate maintenance or replacement. The nameplate of a Contractor will not be acceptable.
- E. If materials or equipment are installed before they have been reviewed by the Architect/Engineer, the Contractor shall be liable for their removal and replacement at no additional expense to the Owner, if in the opinion of the Architect/ Engineer, material or equipment does not meet the intent of the Drawings and Specifications.
- F. This Contractor shall call to the attention of the Architect/Engineer by letter or on shop drawing submittals, any instance in which the shop drawings differ from the requirements of the Drawings and Specifications.
- G. Data and shop drawings shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior approval has been obtained from the Architect/Engineer. In such cases, a list of data to be submitted later shall be included with the first submission. No delays in construction occasioned by the Contractor's failure to submit material in accordance with the approval schedule will be excused.

- H. Catalogs, pamphlets, or other documents submitted to describe items on which review is being requested shall be specific and identifications in catalog, pamphlets, etc., of items submitted shall be clearly made in a contrasting ink. Data of a general nature shall not be acceptable.
- I. Submitted samples, drawings, specifications, catalogs, and the like shall be properly labeled and shall indicate: specified service for which the material or equipment is to be used; Section and Article number of Specifications governing; contractor's name; and name of the job.
- J. Data and shop drawings shall be identified in accordance with Division 1 General Requirements. In addition, shop drawings shall be identified by the name of the item and system and the applicable Specification paragraph number. This Contractor's submissions shall include, but not be limited to the following components/systems described herein and as specified in other Sections of this Specification.
1. Manholes, hand holes, frames and covers.
 2. Conductors.
 3. Cable splicing material.
 4. Dimming system(s).
 5. Boxes including device, junction, outlet, and pull types.
 6. Raceway, conduit and associated fittings.
 7. Disconnect switches.
 8. Dry type transformers.
 9. Low voltage transformers for lighting.
 10. Enclosed circuit breakers.
 11. Fire detection and alarm system.
 12. Bi-Directional Amplification System
 13. Fuses and spare fuse cabinet.
 14. Lighting control systems.
 15. Lighting fixtures including lamps and ballasts.
 16. Panelboards, including distribution and branch circuit.
 17. Supporting devices, anchors and fasteners.
 18. Nameplates, labels and markers.
 19. Wires, cables, and connectors.
 20. Wiring devices.
- K. No item or system listed in the schedule above shall be delivered to the site or installed until successful completion of the review. After review of the proposed materials has been successfully completed, no substitution shall be permitted except where approved by the Architect/Engineer in

writing. Should the Contractor fail to comply with the requirements of this paragraph, the Owner reserves the right to select any and all items and systems required by this Specification. Materials so selected shall be used in the work at no additional expense to the Owner.

- L. The successful review rendered on shop drawings shall not be considered as a guarantee of building conditions. Where drawings have been successfully reviewed, said review does not mean that the drawings have been checked in detail and does not in any way relieve the Contractor from the responsibility, nor the necessity of furnishing the material or performing the work as required by the Drawings and Specifications.
- M. Failure to submit shop drawings that meet the requirements of the Drawings and Specifications in ample time for review shall not entitle the Contractor to an extension of contract time, and no claim for extension by reason of such default shall be allowed.
- N. All equipment and materials to be furnished under this Division of these Specifications shall be as manufactured by the manufacturer(s) listed on the Drawings or herein specified. All requests by any bidder to provide equipment and/or material manufactured by a manufacturer not listed on the Drawings or specified herein must be submitted to the Architect/Engineer not less than seven (7) calendar days prior to the bid date. Request form is available from the Architect's construction administration department. Any and all replies to said requests will be made in the form of an addendum which shall be made available to all bidders. Any equipment and/or materials installed by this Contractor not manufactured by a specified manufacturer or covered under an addendum shall be removed by this Contractor and the proper equipment or materials installed at no additional expense or delay to the Owner.

1.7 SUBSTITUTIONS

- A. Follow provisions of Division 1.
- B. It is the intent of these specifications that wherever a manufacturer or product is specified, and the term "substitution is approved" is used, the substituted item must conform in respects the specified item. Consideration shall not be given to claims that the substituted item meets the performance requirements with lesser construction. Performance indicated in schedules, drawings and specifications shall be interpreted as minimum performance.
- C. Note that where specific manufacturers' products are indicated in the Contract Documents, the associated systems have been designated on the basis of the product's physical characteristics. Where specific manufacturers' products are indicated in the Contract Documents and other manufacturer's names are listed, the associated systems have been designed on the basis of the first-named manufacturer's product.
- D. Where this contractor proposes to use, and/or uses, an item of equipment other than that specified or detailed on the Drawings, which requires any redesign of any other part of the electrical, mechanical, or architectural layout, all such redesign and all new drawings and detailing required shall be prepared by this Contractor at no additional expenses to the Owner and shall be reviewed by the Architect/Engineer.
- E. Where such approved deviation requires a different quantity and arrangement of duct work, piping, wiring, conduit and equipment, this Contractor shall furnish and install any such duct

work, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system at no additional expense to the Owner.

- F. Equipment of one type shall be the products of one manufacturer: similar items of the same classification shall be identical, including equipment, assemblies, parts and components.
- G. Materials furnished shall be determined safe by a nationally recognized testing organization, such as Underwriters Laboratories, Inc., or Factory Mutual Engineering Corporation, and materials shall be labeled, certified or listed by such organizations.
- H. Where a specific manufacturer is specified and other manufacturers' names are listed as equivalent, the bid shall be based upon the specified or equivalent manufacturers only. Any substitutions from the specific or equivalent manufacturers shall be offered as a Bidder's Initiative.
- I. Final acceptance of substitutions shall be at the discretion of the Owner/Engineer:

1.8 PERFORMANCE OF EQUIPMENT

- A. Materials, equipment and appurtenances of any kind, shown on the drawings, hereinafter specified or required for the completion of the work in accordance with the intent of these specifications, shall be completely satisfactory and acceptable in operation, performance and capacity. No approval either written or verbal of any drawings, descriptive data or samples or such material, equipment and/or appurtenance shall relieve the Contractor of his responsibility to turn over the same to the Owner in perfect working order at the completion of the work.
- B. Any material, equipment or appurtenances, the operation, capacity or performance of which does not comply with the drawings and/or specifications requirements or which is damaged prior to acceptance by the Owner shall be held to be defective material and shall be removed and replaced with proper and acceptable materials, equipment and/or appurtenances or put in proper and acceptable working order, satisfactory to the Engineer and Owner, without additional cost to the Owner.

1.9 RECORD DRAWINGS

- A. The Contractor shall be required to maintain a complete set of blue or black line white prints of Contract Drawings and Shop Drawings for record markup purposes throughout the contract period. Mark up drawings during the course of work to show changes and actual installation conditions sufficient to form a complete record for the Owner's purposes. Give particular attention to work which will be concealed and difficult to measure and record at a later date, particularly work which may require servicing or replacement during the life of the building. Include precise locations and elevations of all utility lines installed under this Contract, buried or concealed within or outside the building, including valves or connections, cleanouts, changes in direction, and any other pertinent information.
- B. At the completion of the project, Contractor shall deliver one set of completed "as-built" drawings to the Architect/Engineer.

- C. "As-built" drawings shall be in the form of reproducible prints, free from rips, tears, folds, tape, staples or any other blemish marking xerographic reproduction difficult. "As-built" drawings may be electronic format, in lieu of reproducible prints. Electronic drawing files shall be developed using format compatible with Architect/Engineer's current electronic drawing standard. Electronic files shall be delivered on 3-1/2 inch diskette or CD format.

1.10 ARRANGEMENT OR WORK

- A. Conceal electrical construction running through finished spaces within walls or chases. At suspended ceilings, conceal work above ceiling unless indicated "at ceiling", in which case, work shall be exposed below ceilings.
- B. In finished spaces with or without ceilings coordinates with other work. Follow reflected ceiling plans.
- C. In finished spaces without ceilings, install wiring, conduit, and other work parallel with building lines.
- D. Where physical interferences cannot be resolved readily, prepare composite drawings at a scale of not less than 1/4 inch equals 1'-0". Show work of this Division in relation to other work. Obtain written approval by Engineer/Architect of proposed changes. Distribute drawings to other trades affected. Correct conflicts at no additional cost.
- E. Subject to approval and without extra cost, make modifications in layout as required to prevent conflict with other work or for proper execution of work.
- F. This Division and Division 23 does not permit the following conditions. Advise A/E in writing when:
1. Piping, ductwork, or equipment foreign to electrical construction has been installed in electrical equipment rooms or electrical closets.
 2. Piping or ductwork, has been installed over, around in front of, in back of, or below electrical controls, panels, switches, terminal boxes or similar electrical equipment.
 3. Drip pans have been installed over or around electrical equipment.
- G. Position electrical work for easy unobstructed operation of the building. Obtain required location information sufficiently in advance of installation to allow uninterrupted progress.
- H. Check layouts of equipment with shop drawings of other trades to determine roughing-in requirements. Do not scale drawings for exact locations. Provide a neat arrangement of work to overcome local interferences to best advantage of the Project.
- I. Position lights, smoke detectors, loudspeakers, and similar equipment as shown on reflected ceiling plan. Arrange ceiling outlets symmetrically.
- J. Verify locations of floor outlets with A/E before roughing-in.
- K. Locate switches and other manually, operated devices in a location easily accessible and convenient to operating personnel. If any such devices are mounted in locations not approved, relocate devices at no additional cost.

- L. Do not install aluminum or copper products where they will be encased in concrete.

1.11 QUALIFICATIONS FOR BIDDERS

- A. This Contractor shall examine drawings and Specifications relating to the work of all trades and become fully informed as to the extent and character of work required and its relation to all other work in the project prior to submission of bid or prior to the start of any construction.
- B. Before submitting bid, this Contractor is encouraged to visit the site and examine all adjoining existing buildings, equipment, and space conditions including areas above accessible ceilings on which his work is in any way dependent, for the best workmanship and operation according to the intent of the Specifications and Drawings. This Contractor shall verify dimensions and become fully informed as to the nature and scope of the proposed work and also the conditions under which it is to be conducted. This Contractor shall report to the Architect/Engineer any conditions which, in their estimation, might preclude them from installing the equipment and work in the manner as intended and noted on the Drawings and in this Specification. Failure to take the above precaution shall in no way relieve this Contractor from his obligation to provide the material and work as indicated and as specified at no additional expense to the Owner within the stipulated completion time period.
- C. No consideration or allowance shall be granted for failure to visit the site, or for any alleged misunderstanding of materials to be furnished, or work to be done, it being agreed that tender of proposal carried with it agreement to items and conditions referred to herein or indicated in the Drawings.

1.12 DRAWINGS

- A. The Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Consult the Drawings for the exact location of fixtures and equipment. Where same are not definitely located, this Contractor shall obtain this information from the Architect/Engineer.
- B. This Contractor shall follow the Drawings in laying out work and check the Drawings of other trades to verify spaces in which work is to be installed. This Contractor shall maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, this Contractor shall notify the Architect/Engineer before proceeding.
- C. If directed by the Architect/Engineer, this Contractor shall, at no additional expense to the Owner, make reasonable modifications in the layout as needed to prevent conflict with other trades for proper execution.
- D. When failure by this Contractor to comply with the work set forth in the above paragraphs results in a conflict, the work shall be modified by this Contractor as directed by the Architect/Engineer at no additional expense to the Owner.

1.13 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

1. General Requirements

- a) Divisions 21, 22, and 23 shall provide mechanical equipment with voltages and other electrical characteristics as indicated on the drawings and specifications.

- b) All controllers (starters), enclosed switches (disconnect switches, and variable frequency motor controllers (VFCs), except factory mounted controllers and VFCs, for equipment provided under Divisions 21, 22, and 23, shall be furnished under Divisions 21, 22, and 23 respectively and installed under Division 26. Factory mounted controllers and VFCs are furnished and installed under Divisions 21, 22, and 23. Provide controllers, enclosed switches, and VFCs in accordance with Division 26.
 - c) Divisions 21, 22, and 23 shall submit wiring diagrams to the Architect/Engineer for approval and provide approved diagrams to the Division 26 Contractor so that the electrical work may be properly accomplished.
 - d) It shall be the responsibility of the Divisions 21, 22, 23 and 26 contractors to check for adequacy of supply wiring, overcurrent protection, proper voltage, phase rotation and final location of equipment provided prior to the running of any conduit or wiring. Coordinate with Division 26 to assure proper electrical service is provided to equipment provided under Divisions 21, 22, and 23.
 - e) Equipment connections shall be made through conduit or raceways in accordance with Division 26, except that connections to motors shall be made through liquid tight flexible metal conduit with equipment grounding conductor.
2. Power Requirements
- a) All power wiring, for mechanical equipment provided under Divisions 21, 22, and 23, shall be furnished and installed under Division 26 to the point of final connection (from source to controllers, enclosed switches, or VFCs, and to equipment, motor, or other connection point). Except where specifically indicated otherwise, all power wiring to the point of final connection, for equipment provided under Divisions 21, 22 and 23, shall be accomplished under Division 26.
 - b) Final electrical power connections to all equipment shall be furnished and installed under Division 26. In general, the point of final connection shall be the terminal housing on the equipment, motor, or an integral junction box on the equipment item. If no junction box is furnished, a junction box shall be furnished and installed under Division 26. Wire leads of adequate length to ensure a proper connection at the final location shall be furnished and installed under Division 26.
 - c) Wiring, overcurrent protection devices, voltage, phase, rotation and final location of all equipment provided under Divisions 21, 22, and 23 shall be coordinated with all similar devices and power wiring furnished and installed under Division 26. Coordination shall be accomplished prior to the running of any conduit or wiring.
3. Control Requirements
- a) All control wiring (line voltage and/or low voltage), for mechanical equipment provided under Divisions 21, 22, and 23, shall be furnished and installed under Divisions 21, 22, and 23 respectively. Wiring from power source to all control panels, DDC control panels, controllers, operator work stations (PCs, printers, monitors, and other work station equipment) and other control equipment required for a complete and operable control

system serving mechanical equipment provided under Division 23 shall be furnished and installed under Division 23. All wiring from control panels to control devices for mechanical equipment provided under Division 23 shall be furnished and installed under Division 23. All control wire and conduit shall comply with the National Electric Code and Division 26 of the specification. All control wiring shall be in conduit.

- b) Unless otherwise noted, all temperature control devices, installed pilot devices, and all associated pilot control equipment for all equipment provided under Division 23 shall be furnished and installed under Division 23.
 - c) Electrical control wiring for connection of temperature controllers, push buttons, interlocks in motor controllers, pneumatic switches and like items is specified in the control section(s) in Division 23 and installed by Division 23.
 - d) All motors, mounts, remote mounted push-button controls and all speed control switches for multi-speed motors for all mechanical equipment provided under Divisions 21, 22, and 23 shall be furnished and installed under Divisions 21, 22, and 23 respectively.
4. Specialties
- a) Smoke dampers and combination fire/smoke dampers are furnished and installed under Division 23. Duct mounted smoke detectors are furnished under Division 28 and installed under Division 23. Division 23 Contractor shall coordinate velocity, tube length, and other smoke detector selection criteria with the Division 28 Contractor.
 - b) Smoke damper and combination fire/smoke damper power wiring (line voltage or low voltage) shall be provided under Division 23. HVAC system control wiring to smoke dampers, combination fire/smoke dampers or smoke detectors shall be provided under Division 23. Power wiring to smoke detectors and control wiring from smoke detectors to fire alarm control panel shall be provided under Division 28.
 - c) Smoke dampers and combination fire/smoke dampers and actuators shall be provided under Division 23 and powered, monitored, and controlled under Division 23.
 - d) Room, space, or area smoke detectors are furnished and installed under Division 28.
 - e) Telecom equipment are furnished under Division 27.

1.14 CONTRACTOR'S WARRANTY

- A. This Contractor shall warrant the workmanship, materials, and equipment against defects and/or non-operation for a period of one (1) year (unless longer periods are otherwise herein specified) from the day of final acceptance.

1.15 COOPERATION WITH OTHER TRADES

- A. This Contractor shall give full cooperation to other trades and shall furnish in writing to the Architect/Engineer any information necessary to permit the work of all trades to be installed satisfactorily with the least possible interference or delay.
- B. Where the work of this Contractor will be installed in close proximity to work of other trades, or where there is evidence that work shall interfere with the work of other trades, this Contractor

shall assist in working out space conditions to make a satisfactory adjustment. If directed by the Architect or Engineer, this Contractor shall prepare composite working drawings at a scale not less than 1/4 inch equals 1'-0", clearly showing how the work is to be installed in relation to the work of the other trades. If this Contractor installs the work before coordinating with other trades or as to cause any interference with work of other trades, this Contractor shall make necessary changes to the work to correct the condition at no additional expense to the Owner.

- C. This Contractor shall furnish to other trades, all necessary templates, patterns, setting plans, and shop details for the proper installation of the work and for the purpose of coordinating adjacent work.

1.16 TEMPORARY LIGHT AND POWER SERVICES

- A. Provide temporary power for (construction trailers), facility light and heat, and construction tools as required for the completion of the work of all trades. Refer to Division 1 specification - Temporary Facilities for additional requirements.
- B. Provide temporary lighting for the project site as required by OSHA and all other authorities having jurisdiction.
- C. At the completion of the project, remove all temporary lighting, receptacles, panelboards, wiring, etc. in their entirety.

1.17 GROUNDING

- A. Provide a complete grounding system in accordance with NEC Article 250 and all authorities having jurisdiction.
- B. For grounding and bonding see Section 260526 of these specifications.

1.18 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Follow provisions of Division 1.

1.19 PROJECT RECORD DOCUMENTS

- A. Follow provisions of Division 1.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

- A. Unless otherwise shown on the Drawings or herein specified, each item of equipment furnished by this Contractor shall be essentially the standard product of the manufacturer. Where two (2) or more equipment items of the same kind or class or equipment are required, they shall be the product of a single manufacturer.
- B. For equipment consisting of an assembly of multiple components, such multiple components do not have to be the products of a single manufacturer.

2.2 PERFORMANCE DATA

- A. All performance data specified herein shall be considered actual performance of equipment as installed. If installation details are such that actual operating conditions unfavorably affect

performance as compared to conditions under which the equipment was rated, suitable allowance shall be made by this Contractor.

2.3 QUIET OPERATION

- A. All equipment shall operate under all conditions of load without transmission of sound and/or vibration which is found to be objectionable in the opinion of the Architect/Engineer. In case of sound or vibration noticeable outside of the room or space in which it is installed, or annoyingly noticeable inside its' own room or space, it shall be considered objectionable. Sound or vibration eliminators as recommended to eliminate any objectionable sound or vibration shall be furnished and installed by this Contractor at no additional cost if deemed necessary by the Architect/Engineer.

PART 3 EXECUTION

3.1 INSTALLATION OF WORK

- A. This Contractor shall examine the site and all Drawings before proceeding with the layout and installation of this work.
- B. This Contractor shall arrange the work essentially as shown on the Drawings; exact layout shall be made on the job to suit actual conditions. This Contractor shall confer and cooperate with other trades on the job so all work shall be installed in proper relationship. Precise location of parts to coordinate with other work shall be the responsibility of this Contractor.
- C. This Contractor shall arrange for required sleeves and openings. This Contractor shall be liable for cutting or patching made necessary by failure to make proper arrangements in this respect.
- D. This Contractor shall provide a full time Job Foreman who shall oversee and coordinate the work with other trades and make proper layout of the work to suit the job conditions and to satisfy the general requirements of the Contract.
- E. This Contractor shall coordinate with all other trades and the owner to protect all new work installed under this contract and any existing equipment, devices, wiring or any other appurtenances that are to be part of the finished work.

3.2 DELIVERY AND STORAGE

- A. All materials and equipment shall be delivered in the manufacturer's original packages with seals unbroken and with manufacturer's name and contents legibly marked thereon. This Contractor shall store all materials off the ground, under cover, and protected from the weather and construction.

3.3 SCAFFOLDING, RIGGING, AND HOISTING

- A. Unless otherwise specified, this Contractor shall furnish all scaffolding, rigging, hoisting, shoring, and services necessary for the erection and delivery into the premises of any equipment and apparatus furnished and removal of same from premises when no longer required.

3.4 EXCAVATING AND BACKFILLING

- A. Mass excavation to approximate building level shall be carried out under Division 1 of these Specifications. This Contractor shall do all trench and pit excavation and backfilling required for the electrical work inside and outside the building, including: repairing of finished surfaces; all required shoring, bracing, pumping; and all protection of safety of persons and property. In addition, it shall be the responsibility of this Contractor to check the indicated elevations of utilities entering and leaving the building. If such elevations require excavations lower than the footing levels, the Architect/Engineer shall be notified of such conditions and redesign shall be made before excavations are commenced. It shall also be the responsibility of this Contractor to make the excavations at the minimum required depths in order not to undercut the footings.
- B. Conduits installed below the ground floor level shall have the bottom of the trench excavated to grade so that the conduit shall rest on a solid bed of undisturbed earth. If rock is encountered, the trench shall be excavated to not less than three (3) inches below required grade and filled to required grade with sand so as to provide a solid bed under the entire length of conduit.
- C. Where the trench is excavated below the required depth, the trench shall be filled with sand and fine gravel so that the entire length of conduit rests on solid bed of sand.
- D. Backfilling to one (1) foot above the top of the conduit pipe shall be done by hand, using clean dirt free of rocks or other debris. All backfill shall be properly compacted in accordance with Division 2 of this Specification. Utility tracing tape shall be placed by this Contractor above underground electrical work approximately one (1) foot below finished grade for the entire length of the installation.

3.5 ACCESSIBILITY

- A. This Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work. This Contractor shall cooperate with all other trades whose work is in the same space, and shall advise each trade of their requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
- B. This Contractor shall locate all equipment that must be serviced, operated, or maintained in fully accessible positions. This equipment shall include, but not be limited to, disconnect switches, panelboards, transformers, controllers, switchgear, motor control centers, generators, junction boxes and pullboxes, and the like. If required for better accessibility, this Contractor shall furnish access doors or panels for this purpose. Minor deviations from the Drawings may be made to allow for better accessibility, and all changes shall be approved by the Architect/Engineer.
- C. This Contractor shall furnish and install access panels as required for access to junction boxes, etc. The panels shall be twelve (12) inches square, unless otherwise required to be larger, with hinged metal door and metal frames. Door and frame shall be not lighter than sixteen (16) gauge sheet steel. Access panels shall be the flush type with screwdriver latching device. The frame shall be constructed so that it can be secured to the building material. Access panels and their locations shall meet with the approval of the Architect/Engineer.

3.6 PERSONNEL INSTRUCTION AND OPERATING INSTRUCTIONS

- A. This Contractor shall furnish to the Architect/Engineer for delivery to the Owner, four (4) bound and indexed copies of an approved operations and maintenance instruction booklet along with a copy of the submittal data for each item of equipment installed under this Contract. The submittal data shall include all "special systems" drawings and floor plans, updated to include any deviations to the system(s) and/or the building layout to properly reflect "as built" conditions.
- B. After all tests are conducted and approved as specified below, this Contractor shall furnish a competent operations engineer for a period of two (2) days to instruct and demonstrate to the Owner, or his authorized representative, the operation of each system. This Contractor shall notify the Architect/Engineer in writing of the person to whom this instruction was given and the date given. This Contractor shall provide at least one (1) week's notice to the Owner when conducting tests or demonstrations of equipment.
- C. This Contractor shall furnish to the Contractor as part of the Owner's operating and personnel instruction package, one (1) bound set of marked up drawings indicating any changes made during construction to the original contract drawings. The set shall be clearly labeled, "As Built Plans."
- D. This Contractor shall furnish complete Technical Service Manuals with component schematics and parts lists as indicated in appropriate section for each system.

3.7 EQUIPMENT SUPPLIERS INSPECTION

- A. The following equipment and systems shall not be placed in operation until a competent installation and service representative of the manufacturer has made an on the job inspection of the installation, has certified that the equipment is properly installed and lubricated, that preliminary operating instructions have been given, and that equipment is ready for operation.
 - 1. Fire detection and alarm system.
 - 2. Lighting control systems.
 - 3. Master clock system.
 - 4. Security intrusion system.

3.8 TESTS

- A. This Contractor shall, at his expense, conduct a capacity and general operating test on each system. The test shall demonstrate the specified capacities of the various pieces of equipment, and shall be conducted in the presence of the Architect/Engineer and the Owner. The general operating tests shall demonstrate that the entire equipment system is functioning in accordance with the Drawings and Specifications. This Contractor shall furnish all instructions, test equipment, and utilities.
- B. After all systems are completely tested, this Contractor shall submit four (4) copies of the test results to the Architect/Engineer for review. Final inspection shall not be made until test results have been reviewed by the Architect/Engineer.

3.9 CLEANING

- A. This Contractor shall thoroughly clean all electrical equipment installed under this Division of these Specifications after the system has been completed or used for temporary service, but in any case prior to final inspection by the Owner's representatives.
- B. Cleaning shall include, but not be limited to, lighting fixtures, wiring devices, cover plates, distribution equipment, and the like.

3.10 GUARANTEE

- A. This Contractor shall guarantee by acceptance of the contract that all work installed shall be free from any and all defects in workmanship and/or materials, and that all apparatus shall develop capacities and characteristics specified, and that if during the period of (one (1)) year, from date of certificate of completion and acceptance of work, such defects in workmanship, materials, or performance appear, this Contractor shall with no additional expense to the Owner, remedy such defects within a reasonable time. In default thereof, Owner may have such work done and charge the cost to this Contractor.

3.11 IDENTIFICATION

- A. This Contractor shall furnish an "As-Built" riser diagram indicating service entrance switchboard, panelboards, dimming systems, and safety switches. Diagram shall indicate size of feeders and conduit, breakers, circuit, and fuses. The diagram shall be neatly drawn, using mechanical or Cad drafting methods, at least 24 inches x 36 inches, laminated, and hung from the wall adjacent to service entrance switchboard as directed by the Owner.
- B. This Contractor shall refer to the appropriate sections of these Specifications for identification requirements for junction boxes, branch and feeder conductors, underground wiring, special systems wiring and the like.

3.12 LOCK-OUT/TAG-OUT PROCEDURES

- A. This Contractor shall have an established lock-out/tag-out procedure which meets the requirements of the Owner. This Contractor shall coordinate with the Owner's representative to insure conformance with the Owner's lock-out/tag-out program requirements.

END OF SECTION 260001

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SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Underground wire and cables rated 600V and less
 - 3. Connectors, splices, and terminations rated 600 V and less.
 - 4. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- 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 NFPA 70.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Insulated Wire Corp.; a Leviton Company.
 - 2. General Cable Corporation.
 - 3. Senator Wire & Cable Company.
 - 4. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.
- D. METAL CLAD CABLE
 - 1. Manufacturers:
 - a) AFC – MC
 - b) Alflex – Armorlite MC
 - c) Southwire – MC
 - d) Southwire – HCF MC
 - e) Nexan
 - 2. Standards: NEC Article No. 334 and No 517, Type MC; UL 1569.
 - 3. Description: Single or multi-conductors with insulated green ground wire, overall tape wrap, and flexible galvanized steel armor.
 - 4. Conductors: Copper, rated 600V, Type THHN insulation, 90 degrees C (194 degrees F) rated, minimum size No. 12, maximum size No. 250 Kcmil.
 - 5. Use of MC cable shall be limited to circuits 30A or less

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.

3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions:
 1. Metal-clad cable, Type MC or Type THHN-THWN, single conductors in raceway for non patient healthcare areas
 2. Healthcare Facilities: Type HCF-90 cable or Type THHN-THWN, single conductors in raceway. (for normal circuits only feeding all patient care areas).
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW, single conductors in raceway.
- I. Branch Circuits Installed below Raised Flooring: Metal-clad cable, Type MC.

1. Metal-clad cable, Type MC or Type THHN-THWN, single conductors in raceway for non patient healthcare areas
 2. Healthcare Facilities: Type HCF-90 cable or Type THHN-THWN, single conductors in raceway. (for normal circuits only feeding all patient care areas).
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- K. Emergency circuits: Type THHN-THWN, single conductors in raceway.
- L. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- M. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring unless specified otherwise in other Sections.
- H. Avoid excessive voltage drop by using No. 10 wire for 20 amperes, 120 volt circuits that exceed 75 feet (23 m) to outlet at center of load, for 20 ampere 277 volt circuits that exceed 150 feet (45 m) to outlet at center of load. Use minimum No. 10 wire for the following circuits regardless of voltage:
 1. Three way switching in corridors.
 2. Exterior lights mounted on building.

3. Where home run indicates wire size larger than called for by rating or protective device, continue this wire size throughout circuit unless otherwise noted.
 - I. Place an equal number of conductors for each phase of a circuit in same raceway or cable.
 - J. Splice only in junction or outlet boxes.
 - K. Neatly train and lace wiring inside boxes, equipment and panelboards.
 - L. Make conductor lengths for parallel circuits equal.
 - M. Exercise care in storage and installation of wire and cable to avoid damage to conductors and coverings. Use pulling compound as lubricant for pulling wires into raceway.
 - N. Numbered circuits on drawings are intended to correspond with panelboard connections. Make panel connections so that circuit protectors are in logical operating sequence, and so that loads are balanced within 10 percent across all phases.
 - O. Support conductors in vertical raceways in accordance with NEC requirements. Provide manufactured clamps or compression fittings in bottom of panelboards if space permits, or provide separate pull boxes for fittings where indicated.
 - P. Install wiring in conduit unless otherwise shown or specified.

3.4 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.
- B. Install wire in raceway after interior of building has been protected from weather and after other construction, likely to injure conductors, is complete.
- C. Completely and thoroughly swab raceway system before installing conductors.

3.5 OVERSIZED WIRING

- A. Where oversized wiring has been indicated to overcome voltage drop or for increased ampacity and does not fit properly into equipment served, provide a suitable junction box adjacent to equipment for change of wire size. Verify all locations with engineer prior to installation.
- B. Provide reduced wire size from junction box to equipment. Keep reduced wire size as large as possible, but in no case use wire of ampacity less than that required by NEC to feed equipment.

3.6 FEEDER CIRCUITS

- A. Install feeder circuits in rigid steel conduit. Option: Feeders may be installed in electric metallic tubing, providing the following conditions are strictly adhered to:
 - 1. Do not install metallic tubing in contact with earth, or where prohibited by NEC or local codes.
 - 2. Use compression fittings with insulated throat, or steel compression type for electric metallic tubing.
 - 3. MC Cable shall not be used for feeder circuits
- B. Where two or more feeders pass through a pullbox, tag and identify each with electrical characteristics, source, and destination.

3.7 BRANCH CIRCUITS

- A. Install branch circuits in raceways. Where practical, homeruns to the same panelboard may be grouped in a single raceway. No more than three single phase, or one three phase, 480/277 volt or 208/120 volt circuit may be enclosed in one raceway unless specifically shown. Do not mix voltage in the same raceway.
- B. Provide individual neutral conductor for each phase, wire home run to a panelboard, common neutrals are not allowed.
- C. Mark boxes in ceiling area with panel and branch circuit numbers.
- D. Branch circuits shall only utilize MC cable for circuits 30A or less.

3.8 WIRING WITHOUT CONDUIT (LOW VOLTAGE, CONTROL WIRING ONLY)

- A. Install wiring in conduit, unless otherwise shown or specified.
- B. Where shown or specified, run wiring without conduit overhead at steel framing, and above suspended ceilings. Bundle and tie wiring. Support with bridle rings approximately 54 inches OC. Install wire as slack span; do not pull tight. Maintain at least 6 inch clearance from parallel runs of light and power wiring to avoid inductive coupling. Maintain at least 24 inches clearance from hot water and steam piping.
- C. Provide conduit sleeves through walls and partitions that obstruct horizontal passage of wiring. Seal sleeves after installation of wires.
- D. Provide conduit for cable drops to equipment on walls and floors.
 - 1. In finished spaces, provide recessed boxes for equipment, and conceal conduit in wall. Extend conduit up to ceiling cavity and terminate in an accessible location.

2. In unfinished spaces, provide surface mounted boxes for equipment, and extend conduit up to level of ceiling cavity.
- E. Bundle and tie cables and train neatly in cabinets. Terminate conductors on terminal strips. Leave sufficient slack cable at movable equipment for connections and maintenance. Provide strain relief clamps for cables at movable equipment.

3.9 TERMINAL BLOCKS

- A. Strip conductors feeding terminal blocks cleanly, only to length necessary to make contact with connector plates. Re-trim and reconnect bare conductor extending beyond 1/16 inch.
- B. Tag conductors feeding terminal blocks on both sides of terminal block with "Brady" markers to identify circuit.
- C. Label and number each terminal block connection. Affix a feed chart to cover of terminal box or junction box identifying circuit feeding terminal block.

3.10 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.11 WIRING SPLICES, CONNECTIONS AND TERMINATIONS.

- A. Make wire splices electrically and mechanically secure. Install small wire connectors so that no bare conductor is exposed. Tighten bolts on large conductor connectors so that conductor is deformed, but do not break strands of wire. Use compression tool with proper die for compression connectors in accordance with manufacturer's recommendations. Apply insulation over splice so that insulation thickness is at least 1.5 times that on conductor. Lap applied insulation at least 1 inch over conductor insulation so that no bare conductor is exposed.
- B. Terminate conductors on terminal strips in equipment where terminal strips are used. Provide appropriate connectors, or hook conductors around terminal screws as required.
- C. Connect each wiring device to its neutral conductor with a short jumper, so that removal of device will not interrupt continuity of neutral conductor feeding through box.

- D. Provide encapsulated splice kits for splices in areas subject to moisture, including wet locations inside buildings and underground handholes, manholes, and buried junction boxes. Install splice kit in accordance with manufacturer's recommendations, and make splice waterproof. Apply sealing putty to surround each cable. Install mold body so that resin covers each cable sheath by a minimum of one inch.
- E. Splice only in accessible junction boxes.
- F. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 10 AWG and smaller.
- G. Use compression connectors for copper wire splices and taps, 8 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation value of conductor.
- H. Thoroughly clean wires before installing lugs and connectors.
- I. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- J. Terminate spare conductors with electrical tape or heat/cold shrink end caps.

3.12 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
 - a) HVAC Units
 - b) Motors over 10HP
 - c) UPS Units

- d) Medical Imaging Systems
 - (i) Xray
 - (ii) CT Machines
 - (iii) LINAC
- 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a) Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b) Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c) Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- D. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

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SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL 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. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:

- 1. NEC 517 Grounding for Patient Care Areas

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells ground rings, grounding connections for separately derived systems based on NFPA 70B.
 - a) Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b) Include recommended testing intervals.

1.4 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. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. 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 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

PART 3 EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
- E. 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.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend 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.

- C. 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, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70 and NEC 517:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Branch circuit raceways for Patient care area
 - 8. Armored and metal-clad cable runs.
 - 9. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

- E. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit. Refer to specification 26 41 10 Lightning Protection System for more info on grounding methods specific to lightning protection.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column and building footer steel (rebar), extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building foundation.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a) Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b) Perform tests by fall-of-potential method according to IEEE 81.
3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the

record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

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SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL 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. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.
- D. MC Cable: Metal Clad Cable

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.7 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 installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a) Allied Tube & Conduit.
 - b) Cooper B-Line, Inc.; a division of Cooper Industries.
 - c) ERICO International Corporation.
 - d) GS Metals Corp.
 - e) Thomas & Betts Corporation.
 - f) Unistrut; Tyco International, Ltd.
 - g) Wesanco, Inc.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (i) Cooper B-Line, Inc.; a division of Cooper Industries.
 - (ii) Empire Tool and Manufacturing Co., Inc.
 - (iii) Hilti Inc.
 - (iv) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - (v) MKT Fastening, LLC.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.

5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- F. Exposed raceways shall not be routed in between other raceways.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: 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. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533 – RACEWAY AND BOXES FOR ELECTRICAL 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. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.
- J. MC Cable : Metal Clad Cable
- K. HCF MC Cable: Health Care Facility Metal Clad Cable

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
- C. Qualification Data: For professional engineer and testing agency.

D. Source quality-control test reports.

1.5 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. Comply with NFPA 70.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.
10. Southwire

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. HCF MC Cable and MC Cable: UL 83, UL 1569, and UL 1063

- I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel, compression type.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- J. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; a Hubbell Company.
 - 12. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- D. LFNC: UL 1660.
- E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include 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: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a) Thomas & Betts Corporation.
 - b) Walker Systems, Inc.; Wiremold Company (The).
 - c) Wiremold Company (The); Electrical Sales Division.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet Division.

10. Spring City Electrical Manufacturing Company.
 11. Thomas & Betts Corporation.
 12. Walker Systems, Inc.; Wiremold Company (The).
 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- G. Hinged-Cover Enclosures: NEMA 250, Type 1, 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: Plastic.
- H. Cabinets:
1. NEMA 250, Type 1, 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.

2.6 SLEEVES FOR RACEWAYS

- 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 thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.7 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 3. 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.

PART 3 EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit : Rigid steel conduit.
 - 2. Concealed Conduit, Aboveground: Rigid steel conduit.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated. Deviations from this list shall be brought to the attention of the engineer prior to purchase of material:
 - 1. Exposed, Not Subject to Physical Damage: EMT. Includes raceways in the following locations
 - a) Electrical Rooms
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. All circuit homeruns: EMT
 - 4. Exposed and Subject to Severe Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:
 - a) Loading dock.
 - b) Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

- c) Mechanical or Riser Rooms rooms.
- 5. Concealed in Ceilings and Interior Walls and Partitions: EMT or MC cable
- 6. Concealed in Ceilings and Interior Walls and Partitions for last 6 feet of branch circuits serving patient care areas: HCF-MC Cable or EMT
- 7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
- 8. Damp or Wet Locations: Rigid steel conduit.
- 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size unless otherwise noted.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. 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.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway 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.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, 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 raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b) Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c) Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
 - d) Attics: 135 deg F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- O. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- P. 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.
- Q. Set metal floor boxes level and flush with finished floor surface.
- R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. 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.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. 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.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall 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.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.4 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.6 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

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SECTION 260548 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL 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. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

- B. Related Sections include the following:

1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
 - a. Component Importance Factor: 1.5.
 - b. Component Response Modification Factor: 3.5.

- B. Component Amplification Factor: 2.5.

1. Design Spectral Response Acceleration at Short Periods (0.2 Second): As specified by structural engineer.
2. Design Spectral Response Acceleration at 1.0-Second Period: As specified by structural engineer.

1.5 ACTION 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. Restrained-Isolation Devices: 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 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 and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other electrical Sections for equipment mounted outdoors.
 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 3. Field-fabricated supports.
 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. Preapproval 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).

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For professional engineer and testing agency.

- C. Welding certificates.
- D. Field quality-control test reports.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved 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.
- E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.

- C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- D. 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- 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.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti Inc.
 5. Loos & Co.; Seismic Earthquake Division.
 6. Mason Industries.
 7. TOLCO Incorporated; a brand of NIBCO INC.
 8. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements 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: 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.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. 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.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: 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.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 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.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables 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 indicated or scheduled on Drawings to receive them and 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.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
 - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- A. 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.
- B. 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.
- C. 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.
 - 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. 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.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after isolated equipment 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.

END OF SECTION

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SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Identification for Emergency System
 - 9. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Normal Power: Black letters on an orange field.
 - 2. Emergency Power: White Letters on a white field
 - 3. Legend: Indicate voltage and system or service type. Emergency power identification shall indicate branch of emergency power.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- F. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
 1. Normal Power: Black letters on an orange field.
 2. Emergency Power: White Letters on a white field
 3. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- F. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.5 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.

3. Nominal size, 10 by 14 inches.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.8 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.9 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.10 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.

4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes

where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

- J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:
1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.
- D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Normal Power.
 2. Emergency Power.
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a) Color shall be factory applied.
 - b) Colors for 208/120-V Circuits:
 - (i) Phase A: Black.

- (ii) Phase B: Red.
- (iii) Phase C: Blue.
- (iv) Neutral: White
- (v) Ground: Green
- c) Colors for 480/277-V Circuits:
 - (i) Phase A: Brown.
 - (ii) Phase B: Orange.
 - (iii) Phase C: Yellow.
 - (iv) Neutral: Gray
 - (v) Green with Yellow stripe
- d) Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- G. Emergency Sources: A sign shall be placed at the service entrance equipment indicating the type and location of an on-site emergency power source per NEC 700
- H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless

otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Metal-backed, butyrate warning signs.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a) Power transfer switches.
 - b) Controls with external control power connections.
- M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a) Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b) Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c) Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d) Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 - 2. Equipment to Be Labeled:
 - a) Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.

- b) Enclosures and electrical cabinets.
- c) Access doors and panels for concealed electrical items.
- d) Switchboards.
- e) Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- f) Emergency system boxes and enclosures.
- g) Enclosed switches.
- h) Enclosed circuit breakers.
- i) Enclosed controllers.
- j) Variable-speed controllers.
- k) Push-button stations.
- l) Power transfer equipment.
- m) Trystar Docking Station
- n) Contactors.
- o) Remote-controlled switches, dimmer modules, and control devices.
- p) Monitoring and control equipment.

END OF SECTION 260553

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SECTION 260923 – LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Indoor occupancy sensors.
 - 2. Lighting contactors.
 - 3. Emergency shunt relays.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for all lighting systems devices in order to provide a complete working system.
 - 1. Interconnection diagrams and floor plans showing field-installed wiring from light fixtures to all control devices including but not limited to:
 - a) Occupancy sensors
 - b) Dimming and Non dimming Wall switches
 - c) UL 924 devices for emergency power
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Area Lighting Research, Inc.; Tyco Electronics.
 - 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 3. Intermatic, Inc.
 - 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 5. Novitas, Inc.
 - 6. Paragon Electric Co.; Invensys Climate Controls.
 - 7. Square D; Schneider Electric.
 - 8. TORK.
 - 9. Touch-Plate, Inc.
 - 10. Watt Stopper (The).
- B. Description
 - 1. Passive Infrared sensors shall have a multiple segmented Lodif Fresnel lens with grooves-in to eliminate dust and residue build-up.
 - 2. Wall switches shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.
 - 3. Passive Infrared and Dual Technology sensors shall have fully automatic operation, offer daylighting foot-candle adjustment control, be able to accommodate dual level lighting, and respond only to those signals caused by human motion.
 - 4. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).

5. Ceiling mount sensors shall provide a minor motion coverage range of 150 to 1300 square feet with an overall 1/2 step coverage range from 300 to 2000 square feet.
6. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
7. Wall switch sensors shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.
8. Occupancy sensors shall provide coverage of 90 to 100% of the controlled area.
9. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability
10. Wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.
11. Occupancy sensors shall be capable of operating normally with electronic ballasts, PL lamp systems, and rated motor loads.
12. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
13. All sensors shall have readily accessible, user adjustable controls for time delay and sensitivity. Controls shall be recessed to limit tampering.
14. In the event of failure, a bypass manual "override on" feature shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. The override feature shall be designed for use by building maintenance personnel and shall not be readily achieved by building occupants.
15. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
16. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within $\pm 0.005\%$ tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
17. All sensors shall provide an LED indication light to verify that motion is being detected during both testing and normal operation and that the unit is working. All sensors shall be equal to Acuity model numbers or Engineer approved equivalent as specified in the drawings
18. Decibel levels for ultrasonic sensors shall comply with the following criteria:

Mid frequency of Sound Pressure Third Octave Band (KHz micropascals)	Maximum dB level within Third Octave Band in dB reference 20
Less than 20	80
or more to less than 25	105

or more to less than 31.5	110
or more	115

19. All sensors shall have no leakage current in OFF mode and shall have voltage drop protection.
20. All sensors shall have UL rated, 94V-0 plastic enclosures.
21. Sensors shall be suitable for N.E.C. 725 Class 2 wiring and use plenum cable when required.

2.2 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Allen-Bradley/Rockwell Automation.
 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 3. Eaton Electrical Inc.; Cutler-Hammer Products.
 4. GE Industrial Systems; Total Lighting Control.
 5. Grasslin Controls Corporation; a GE Industrial Systems Company.
 6. Hubbell Lighting.
 7. Lithonia Lighting; Acuity Lighting Group, Inc.
 8. MicroLite Lighting Control Systems.
 9. Square D; Schneider Electric.
 10. TORK.
 11. Touch-Plate, Inc.
 12. Watt Stopper (The).
- B. Description: Electrically operated and electrically held, combination type with fusible switch, complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as scheduled, matching the NEMA type specified for the enclosure.

2.3 EMERGENCY SHUNT RELAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Lighting Control and Design, Inc.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 or 277 V.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 16 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors or UL 924 devices.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

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

3.7 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section to owner designated end users.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260923

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SECTION 262200 – LOW-VOLTAGE TRANSFORMERS

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.
- B. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

1.2 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - 1. Distribution transformers.

1.3 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- 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.
- C. Qualification Data: For testing agency.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

C. 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.

D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. General Electric Company.
3. Siemens Energy & Automation, Inc.
4. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: ANSI 49 gray.
- E. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".
- J. Wall Brackets: Manufacturer's standard brackets.

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 2. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

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SECTION 262416 – PANELBOARDS

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. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge Protective Device.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.
 - 7. The submittal for this section shall be submitted concurrently with the Short Circuit/Coordination Study/Arc Flash Hazard Analysis submittal.
- C. Qualification Data: For qualified testing agency.
- D. Field Quality-Control Reports:

1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. 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.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a) Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b) Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.
 2. Do not proceed with interruption of electric service without Owner's written permission.
 3. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

1.10 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. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
 - 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a) Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b) Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 3. Finishes:
 - a) Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b) Back Boxes: Galvanized steel.
 - 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Compression type.
 - 3. Ground Lugs and Bus-Configured Terminators: Compression type.

- 4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 4. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

4. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only, refer to drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Square D; a brand of Schneider Electric.
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 4. Siemens Energy & Automation, Inc.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a) Instantaneous trip.
 - b) Long- and short-time pickup levels.
 - c) Long- and short-time time adjustments.
 - d) Ground-fault pickup level, time delay, and I_{2t} response.
 4. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 5. Dwelling Unit Bedrooms/Living Rooms: Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a) Standard frame sizes, trip ratings, and number of poles.
 - b) Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.

- c) Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
- d) Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- e) Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- f) Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.

- G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- I. Comply with NECA 1.
- J. Install Arc Fault Hazard labels on all panelboards and instruct the owner on Arc Fault Hazard requirements.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
 - a) Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b) Instruments and Equipment:
 - (i) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 1. Measure as directed during period of normal system loading.
 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

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SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 1. Standard-grade receptacles, 125 V, 20 A.
 2. GFCI receptacles, 125 V, 20 A.
 3. Twist-locking receptacles.
 4. Receptacles with integral surge suppression units.
 5. Wall-box motion sensors.
 6. Isolated-ground receptacles.
 7. Hospital-grade receptacles, 125V, 20 A.
 8. Tamper resistant receptacles.
 9. Toggle switches, 120/277V, 20A.
 10. Pendant cord-connector devices.
 11. Cord and plug sets.
 12. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.
- H. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Receptacles for Owner Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- 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 NFPA 70.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Service/Power Poles: One for every 10, but no fewer than one.
 2. Floor Service Outlet Assemblies: One for every 10, but no fewer than one.
 3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than one.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices by Eaton
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Pass & Seymour/Legrand.

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING DEVICE REQUIREMENTS

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

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

G. Device colors:

1. Wiring Devices Connected to Normal Power System: To be determined by architect
2. Wiring Devices Connected to Emergency Power System: Red.
3. SPD Devices: Blue.
4. Isolated Ground Receptacles: Orange.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 20A

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Similar by Pass & Seymour.

- B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD, and FS W-C-596.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 8300 (duplex).
 - b. Hubbell; HBL8300H (duplex).
 - c. Similar by Pass & Seymour.
 2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
 3. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.
- C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; IG8200 (duplex).
 - b. Hubbell IG8300 (duplex).
 - c. *Similar by Pass & Seymour.*
 2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts
- D. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TR8300 (duplex)..
 - b. Hubbell; 5352TR (duplex)..
 - c. Similar by Pass & Seymour.
 2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.
- 2.4 GFCI RECEPTACLES, 125 V, 20A
- A. General Description:
1. Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire and self-grounding.
 2. Straight blade, non-feed-through type.
 3. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and FS W-C-596.
 4. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

- B. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper: TRSGFH20 (duplex).
 - b. Hubbell; GFR8300TR (duplex).
 - c. Similar by Pass & Seymour.
- C. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with UL 498 Supplement SD, and FS W-C-596.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; SGFH20 (duplex).
 - b. Hubbell; GRF8300 (duplex).
 - c. Similar by Pass & Seymour.

2.5 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
- B. Single Convenience Receptacles, other than 125 V, 20 A: As specified on drawings.
- C. Isolated Ground, Single-Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper.
 - b. Hubbell.
 - c. Pass & Seymour.
 - 2. Description:
 - a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
 - b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.6 PENDANT CORD-CONNECTOR DEVICES

- A. Description:
 - 1. Matching, locking-type plug and receptacle body connector.
 - 2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
 - 3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching

- external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.
 5. Standards: Comply with FS W-C-596.

2.7 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES, 120/277 V, 20A

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; CSB120 (single pole), CSB220 (two pole), CSB320 (three way), CSB420 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Similar by Pass & Seymour.

C. Pilot Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; AH1221PL for 120 V and 277 V.
 - b. Hubbell; HBL1221PL for 120 V and 277 V.
 - c. Similar by Pass & Seymour.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper: AH1191L.
 - b. Hubbell; HBL1221RKL.
 - c. Similar by Pass & Seymour.
2. Description: Single pole, with factory-supplied key in lieu of switch handle.

- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1557.
 - b. Similar by Pass & Seymour.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1557L.
 - b. Similar by Pass & Seymour.

2.9 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Constantly Cleaned Spaces (This includes kitchens, clean rooms, and pharmacy areas at a minimum): 0.035-inch- thick, satin-finished, #302 stainless steel. Material for Finished Spaces: 0.035-inch- thick, satin-finished, #302 stainless steel. Material for Unfinished Spaces: 0.035-inch- thick, satin-finished, #302 stainless steel.
 - a. In rooms with ungrounded power, all devices served by non-isolated power shall be provided with nylon wall plates. Nylon plate to match color of device.
 - 3. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather- resistant thermoplastic with lockable cover.
- D. Wall Plates: Satin finished #302 Stainless Steel, unless otherwise noted. Impact resistant nylon plates with nylon screws for special applications as listed below.
- E. Nylon wall plates shall match device color. Stainless steel wall plates shall be natural finish.

2.10 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Round, solid brass with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, hospital grade, unless otherwise indicated.

- E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.11 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- B. Manufacturer: As specified on drawings or approved equivalent.
- C. Standards: Comply with scrub water exclusion requirements in UL 514.
- D. Service-Outlet Assembly: As indicated on drawings.
- E. Size: Selected to fit nominal 3-inch or 4-inch cored holes in floor and matched to floor thickness.
- F. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
- G. Closure Plug: Arranged to close unused 3-inch or 4-inch cored openings and reestablish fire rating of floor.
- H. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 27 "Communications Copper Horizontal Cabling."

2.12 PREFABRICATED MULTIOUTLET ASSEMBLIES

- A. Description: Two-piece surface metal raceway, with factory-wired multioutlet harness.
- B. Manufacturer: As specified on drawings or approved equivalent.
- C. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- D. Raceway Material: Metal, with manufacturer's standard finish.
- E. Multioutlet Harness:
 - 1. Receptacles: 20-A, 125-V, NEMA WD 6 Configuration 5-20R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
 - 2. Receptacle Spacing: 12 inches or as specified on drawings.
 - 3. Wiring: No. 12 AWG solid, Type THHN copper, two circuit, connecting alternating receptacles.

2.13 SERVICE POLES

- A. Dual-Channel Service Poles:
 - 1. Manufacturer: As specified on drawings or approved equivalent.
 - 2. Description: Factory-assembled and -wired units to extend power and voice and data

- communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
3. Poles: Nominal 2.5-inch- square cross-section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
 4. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
 5. Material: Aluminum.
 6. Finishes: Manufacturer's standard painted finish and trim combination.
 7. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, balanced twisted pair data communication cables.
 8. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.
 9. Data Communication Outlets: Blank insert with bushed cable opening.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. For CPN and medical offices and offices: use Hospital Grade in patient areas.
- C. Coordination with Other Trades:
 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- D. Conductors:
 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.

E. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. Each receptacle or switch shall be connected by "pigtail" extensions from the branch circuit. All devices shall be wired so that only one wire is connected to each terminal. Looping or feeding through phase, neutral, or ground conductors is not permitted.
6. Wiring devices shall not be installed in masonry or brick until acid cleaning has been completed.
7. All devices rated at 20 amperes shall be grounded with a #12 AWG minimum size equipment grounding conductor.
8. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
9. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
10. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
11. Tighten unused terminal screws on the device.
12. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
13. Coordinate outlet penetrations and wall plate types in fire-rated partitions. Comply with applicable UL and STI requirements to maintain integrity of fire rating.

F. Receptacle Orientation:

1. Receptacles shall be installed vertically with ground pin at the top.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening. Plates shall be plumb to within 1/16", and installed with no gaps between wall and plate.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates. Coordinate standard orientation with owner.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles and switches: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with white letters on black background for normal power circuits and white letters on red background for emergency power circuits, on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight-blade convenience outlets in patient-care areas and hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

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SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, 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.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper. Provide in PDF and electronic format.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings are diagrammatic concerning size of enclosed switches and circuit breakers, coordinate size and clearances between enclosures, and adjacent surfaces and other items.
- D. 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.

- E. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

1.9 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- 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."

2.2 GENERAL

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and

adjacent surfaces and other items. Comply with indicated maximum dimensions.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.
- E. Provide ground bus, and where required, isolated solid neutral bus.
- F. Enclosures shall be sheet steel, NEMA 1 for indoor installation, NEMA 3R at a minimum for outdoor, with provisions for padlocking in "OFF" position but not in the "ON" position.
- G. All switches shall be heavy duty type, quick make, and quick break.
- H. Switches shall be NEMA 1 enclosure for indoor locations, NEMA 3R at a minimum for outdoors.
- I. The switch handle shall be capable of being padlocked in the "OFF" position but not in the "ON" position
- J. Switches serving motors with more than one set of windings shall have number of poles adequate to disconnect all power with one switch.

2.3 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric.
 - 2. Eaton Cutler-Hammer
 - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 240 and 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Cutler-Hammer
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 240 and 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 4. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.

2.3 RECEPTACLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.

- B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 240 or 600-V ac, 30, 60, or 100 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 240 or 600-V ac, 30, 60, or 100 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.
- E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).
 - 1. Receptacle Manufacturer and Catalog Number: As specified on drawings.

2.4 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Ferraz Shawmut, Inc.
 - 3. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 240 or 600-V ac, amperage as indicated on drawings; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch: 240 or 600-V ac, amperage as indicated on drawings; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- E. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- F. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight red ON pilot light.
 - 3. Isolated neutral lug; 100 percent rating.

4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.

2.5 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Square D; a brand of Schneider Electric.
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents. Circuit breakers shall have removable screw type lugs rated for 74 degrees C where available. Provide ground bus and isolated neutral bus.
- C. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- D. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- E. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 80 percent rated.
- F. MCCBs shall be equipped with a device for locking in the isolated position.
- G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I^2t response.
- K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- M. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- N. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- O. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical or Compression type, suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 4. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero- sequence current transformer/sensor.
 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
- P. Circuit breakers shall have removable screw type lugs rated for 75 degrees C.

2.6 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

- D. Features and Accessories:
 - 1. Standard frame sizes and number of poles.
 - 2. Lugs: Mechanical or compression type, suitable for number, size, trip ratings, and conductor material.
 - 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero- sequence current transformer/sensor.
 - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.7 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1); gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12); a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel); copper-free cast aluminum alloy (NEMA 250 Types 7, 9).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover, directly operable through the front cover of the enclosure (NEMA 250 Type 1), directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R), or externally operable with the operating mechanism being an integral part of the cover (NEMA 250 Types 7, 9). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Where the nameplate rating of the supplied equipment requires service from a fused device, provide a fused disconnect in lieu of any non-fused disconnect shown on the drawings at no extra cost.
- F. Install fuses in fusible devices.
- G. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.

- a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Tests and Inspections for Molded Case Circuit Breakers:

- 1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that the unit is clean.
 - e. Operate the circuit breaker to ensure smooth operation.

- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
 - h. Perform adjustments for final protective device settings in accordance with the coordination study.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Provide an alternate cost to the owner to provide NETA 3rd party primary injection testing for all electronic circuit breakers installed in any equipment in the system rated greater than 250A. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

- 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
- f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in the facilities power system study

END OF SECTION

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SECTION 265119 – LED INTERIOR LIGHTING

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. Interior solid-state luminaires that use LED technology.
2. LED electronic drivers.
3. Lighting fixture supports.
4. Luminaire Accessories.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.

5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 6. Photometric data and adjustment factors based on laboratory tests complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project; IES LM-79 and IES LM-80.
 - a) Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b) Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 7. Certificates for Dimming Drivers: Manufacturer's documentation of compatibility with dimming controls to be installed.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams and floor plans for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting luminaires.
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 4. Structural members to which equipment and/or luminaires will be attached.
 5. Initial access modules for acoustical tile, including size and locations.
 6. Items penetrating finished ceiling, including the following:
 - a) Other luminaires.
 - b) Air outlets and inlets.
 - c) Speakers.
 - d) Sprinklers.
 - e) Access panels.
 - f) Ceiling-mounted projectors.

7. Moldings.

- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of luminaire.
- E. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 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. Replaceable LED Modules or LED lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

- E. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
- B. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- C. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Provide five year warranty for all LED Luminaires, including LED modules, luminaires, and drivers.
- C. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Bulb shape complying with ANSI C79.1.
- F. Lamp base complying with ANSI C81.61.
- G. CRI of minimum 90. CCT of [3500 K]
- H. Rated lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 1 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: Universal multi-volt (120-277V)
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- L. Housings:
 - 1. Formed steel housing or aluminum as per fixture schedule and aluminum heat sink. Provide with painted after fabrication finish.

2.3 EXIT SIGNS

- A. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single or double as indicated on the drawings or as required for the installed location.
 - 2. Directional Arrows: As indicated on the drawings or as required for the installed location.
- B. Accessories:
 - 1. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
 - 2. Provide compatible accessory wire guards where indicated.

2.4 ELECTRONIC LED DRIVERS

A. Dimmable LED Drivers:

1. Dimming Range: Continuous dimming from 100 percent to one percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed.
3. Driver shall be available in a plastic/metal can or metal can construction to meet plenum requirements.
4. Driver shall be provided with poke-in wire trap connectors or integral leads color per ANSI C82.11
5. Performance:
 - a) Driver shall operate from 60Hz input source of 120V with sustained variations of plus or minus 10 percent (voltage and frequency) with no damage to the Driver.
 - b) Driver output shall be regulated to +/- 5% across published load range.
 - c) Driver shall operate LED's at a frequency of 60Hz
 - d) Driver shall have a Power Factor greater than 0.90 for primary application.
 - e) Driver input current shall have Total Harmonic Distortion (THD) of less than 20 percent.
 - f) Driver shall have a Class A sound rating.
 - g) Driver shall have a minimum operating temperature of -40 degrees Fahrenheit.
 - h) Driver shall tolerate sustained open circuit and short circuit output conditions without damage and without need for external fuses or trip devices.
6. Regulatory Requirements:
 - a) Driver shall not contain and Polychlorinated Biphenyl (PCB)
 - b) Driver shall be Underwriters Laboratories (UL) listed, Class 2 outdoor.
 - c) Driver shall comply with ANSI C62.41 Category A for transient protection.
 - d) Driver shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 15, Non-consumer (Class A) for EMI/RFI (conducted and radiated).
7. Other Requirements:
 - a) Driver shall be manufactured in a factory certified to ISO 9002 Quality System Standards.
 - b) Driver shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 90C.
 - c) Manufacturer shall have fifteen year history of producing electronic drivers for the North American market.
 - d) Dimmable drivers shall be controlled by a Class 2 low voltage 0-10VDC controller.

2.5 LED LIGHT SOURCES

A. Light Sources - General Requirements:

1. Unless explicitly excluded, provide new, compatible, operable light sources in each luminaire.
2. Verify compatibility of specified light source with luminaires to be installed. Where light sources are not specified, provide light sources per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide light sources complying with all current applicable federal and state light source efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of light source, furnish products which are consistent in perceived color temperature. Replace light sources that are determined by the Architect to be inconsistent in perceived color temperature.

B. Light Source - Sustainable Design Requirements:

1. The light source in the luminaire and associated shielding shall provide a high efficacy for energy savings to meet the requirements of LEED certification.
2. Minimum Rated Life:
 - a) LED light sources shall have a minimum life of 50,000 hours based on three hours per start.

C. Linear LED light sources: Wattage and light source type as indicated for luminaire.

1. LED Modules:

- a) LED single point diodes or arrays shall be manufactured by Acuity, Cree, Nichia, Lumileds or Osram. Provide a sample of the fixture to be used, if requested.
- b) The array shall have color temperature of 3500>, +/- 100 degrees Kelvin. The LED bin codes shall be consistent for LED Modules used with a higher level of efficiency.
- c) Provide a listing of the bin code information in the submittal for review. Driver shall be of a high efficiency type with 0-10Volt dimming control available as standard.
- d) Photometric performance of fixture shall be in compliance with IES LM-79 and stated predicted lifetime shall be tested so that lumen depreciation shall be in compliance with IES LM-80.
- e) Solid state lighting shall be in compliance with ANSI C78.377 for chromaticity specifications.

2. LED Lamps:

- a) LED self-contained lamps with integral drivers.
- b) Medium base (E-26) or candelabra type base (E-12).
- c) Dimmable Standard A-19 frosted type design or various shaped Edison-style filament vintage lamp design.

2.6 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.

2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
1. Prismatic acrylic
 2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 3. Glass: Annealed crystal glass unless otherwise indicated.
 4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
1. Formed steel housing or aluminum as per fixture schedule and aluminum heat sink.
 2. Provide with painted after fabrication finish.
- E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
 - a) "USE ONLY" and include specific lamp type.
 - b) Lamp diameter, shape, size, wattage, and coating.
 - c) CCT and CRI for all luminaires.

2.7 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.8 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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 luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.

3. Trim ring flush with finished surface tight to mounting surface with no visible light leakage.
 4. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 5. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- F. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls
 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
1. Ceiling mount with two or as required 5/32-inch diameter aircraft cable supports adjustable to architect selected length.
 2. Ceiling mount with pendant mount at architect selected height.
 3. Ceiling mount with hook mount.
- H. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
 - a) In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
 - b) See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Comply with manufacturer's requirements for startup.

3.7 CLEANING OF FIXTURES

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

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SECTION 270526 – GROUNDING AND BONDING FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding rods.
 - 5. Grounding labeling.

1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TGB: Telecommunications grounding busbar.
- D. TMGB: Telecommunications main grounding busbar.

1.4 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.

1.5 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.

1.6 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.

1.7 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 ITS Installer 2 to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

- A. Comply with J-STD-607-A.

2.2 CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Harger Lightning & Grounding.
 - 2. Panduit Corp.
 - 3. TE Connectivity Ltd.
- 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 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.

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 kmils, 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.

2.3 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Burndy; Part of Hubbell Electrical Systems.
 2. Harger Lightning & Grounding.
 3. Panduit Corp.
 4. TE Connectivity Ltd.
- B. 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.
- C. 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.
- D. 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.
- E. Busbar Connectors: Cast silicon bronze, solderless 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.

- F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chatsworth Products, Inc.
 - 2. Harger Lightning & Grounding.
 - 3. Panduit Corp.
- B. 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 clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 - 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.
- C. 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 clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 - 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. 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 long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.5 GROUND RODS

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

1. Harger Lightning & Grounding.
2. TE Connectivity Ltd.

B. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

2.6 LABELING

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

3.1 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.

3.2 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.

3.3 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. 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.
- C. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- D. 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.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG. The TBB between TMGB and each TGB shall be No. 3/0 AWG.

3.5 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.

3.6 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 kmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-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.

3.7 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.

3.8 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!"

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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.
- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
 - D. Grounding system will be considered defective if it does not pass tests and inspections.
 - E. Prepare test and inspection reports.

END OF SECTION

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SECTION 270528 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. 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. Metallic surface pathways.
 - 7. Hooks.
 - 8. Boxes, enclosures, and cabinets.
 - 9. Polymer-concrete handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Surface pathways
 - 2. Wireways and fittings.
 - 3. Boxes, enclosures, and cabinets.
 - 4. Underground handholes and boxes.
- B. Shop Drawings: For custom enclosures and cabinets and custom underground handholes and boxes. Include plans, elevations, sections, and attachment details.

1.5 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.
 - 3. Underground ducts, piping, and structures in location of underground enclosures and handholes.
- B. Qualification Data: For professional engineer registered in North Carolina.
- C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Tube & Conduit; a part of Atkore International.
 - 2. Anamet Electrical, Inc.
 - 3. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 4. Republic Conduit.
 - 5. Thomas & Betts Corporation; A Member of the ABB Group.
 - 6. Wheatland Tube Company.
- C. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - 2. Comply with TIA-569-C.
- D. GRC: Comply with ANSI C80.1 and UL 6.
- E. ARC: Comply with ANSI C80.5 and UL 6A.
- F. IMC: Comply with ANSI C80.6 and UL 1242.
- G. PVC-Coated Steel Conduit: PVC-coated GRC.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.

- H. EMT: Comply with ANSI C80.3 and UL 797.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.
 - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Tube & Conduit; a part of Atkore International.
 - 2. Anamet Electrical, Inc.
 - 3. Carlon; a brand of Thomas & Betts Corporation.
 - 4. Condux International, Inc.
 - 5. RACO; Hubbell.
- C. General Requirements for Nonmetallic Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Comply with TIA-569-C.
- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. Rigid HDPE: Comply with UL 651A.
- F. Continuous HDPE: Comply with UL 651A.
- G. RTRC: Comply with UL 2515A and NEMA TC 14.
- H. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
- I. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS (INNERDUCT)

- A. Materials & Equipment: Labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the intended use.
- B. White Polyester and Nylon resin
- C. Flexible optical fiber/communication raceway.
- D. Provide wire management in a building for fiber optic and data and communications cabling.
- E. A non-metallic raceway, usually circular, placed within a larger raceway. (Sub duct)
- F. MANUFACTURERS
 - 1. Provide products offered by MaxCell Group/TVC Communications 600 Plum Creek Dr. Wadsworth, OH. 44281 1-888-387-3828
 - 2. Or approved equal.
- G. TEXTILE INNERDUCT
 - 1. Standard Outdoor Textile Innerduct: Micro (33mm), 4-inch multi-cell polyester/nylon textile innerduct containing 1250lb polyester flat woven pull tape.
 - 2. Detectable Outdoor Textile Innerduct: Micro (33mm), 4-inch multi-cell polyester/nylon textile innerduct containing 1250lb polyester flat woven pull tape, and a solid copper, polyvinyl color coated conductor (19AWG minimum) for tracing and rated for a minimum of 6 amps and 600 volts. Conductor shall be placed in the sidewall edge fold of the textile sleeve.
 - 3. Indoor Textile Innerduct (Riser-listed): Micro (33mm), 4-inch multi-cell nylon textile innerduct containing 1250lb polyester flat woven pull tape which meets UL2024A for flame propagation and smoke density values for general applications.
- H. Pull Tape: measuring and pulling tape constructed of synthetic fiber, printed with accurate sequential footage marks. Color-coded.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Hoffman; a brand of nVent.
 - 3. MonoSystems, Inc.
- C. General Requirements for Metal Wireways and Auxiliary Gutters:
 - 1. Comply with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 3. Comply with TIA-569-C.
- D. 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.
- E. Wireway Covers: Hinged type unless otherwise indicated.
- F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. 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.
- B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Moulded Products, Inc.
 2. Carlton; a brand of Thomas & Betts Corporation.
 3. Hoffman; a brand of nVent.
- D. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 2. Comply with TIA-569-D.
- 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. Solvents and Adhesives: As recommended by conduit manufacturer.

2.6 SURFACE METAL PATHWAYS

- A. Description: Galvanized steel with snap-on covers, complying with UL 5.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. MonoSystems, Inc.
 2. Panduit Corp.
 3. Wiremold / Legrand.

- C. Finish: Manufacturer's standard enamel finish in color selected by Architect.
- D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- E. Comply with TIA-569-C.

2.7 HOOKS

- A. Description: Prefabricated sheet metal cable supports for telecommunications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. MonoSystems, Inc.
 - 2. Panduit Corp.
 - 3. Caddy
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-C.
- E. Galvanized steel.
- F. J shape.

2.8 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Adalet.
 - 2. Carlon; a brand of Thomas & Betts Corporation.
 - 3. Crouse-Hinds, an Eaton business.
 - 4. FSR Inc.
 - 5. MonoSystems, Inc.
- C. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Comply with TIA-569-C.

2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
 5. Gangable boxes are prohibited.
- D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- F. Metal Floor Boxes:
1. Material: Cast metal or sheet metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. 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. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- I. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Cabinets:
1. NEMA 250, Type 1 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.

2.9 POLYMER-CONCRETE HANDHOLES

- A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. NewBasis.
 - 2. Oldcastle Enclosure Solutions.
 - 3. Quazite: Hubbell Power Systems, Inc.
- C. General Requirements for Polymer Concrete Handholes:
 - 1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 3. Comply with TIA-569-C and SCTE 77.
- D. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 2. Cover Legend: Molded lettering, "COMMUNICATIONS".
- F. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- G. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.10 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer licensed in North Carolina shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.
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.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: GRC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables.

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 compression, cast-metal 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.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.

2. NECA/BICSI 568.
 3. TIA-569-C.
 4. NECA 101
 5. NECA 102.
 6. NECA 105.
 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270528.29 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. 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.
- F. Complete pathway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. 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.
- I. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Pathways Embedded in Slabs:
1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from nonmetallic conduit and fittings to GRC and fittings before rising above floor.
- L. Stub-ups to Above Recessed Ceilings:
1. Use EMT for pathways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- M. 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.
- N. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- O. 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.
- P. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- Q. 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.
- R. 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.
- S. 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. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- T. 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.
- U. 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.
 - 3. 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.
- V. 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.

- W. 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.
- X. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- Y. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Hooks:
1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
 2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
 3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
 4. Space hooks no more than 5 feet o.c.
 5. Provide a hook at each change in direction.

- AA. 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.
- BB. 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.
- CC. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- DD. 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.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe of less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete around conduit for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, 36" below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 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."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 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

SECTION 270529 – HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems for communication raceways.
 - 2. Aluminum slotted support systems for communication raceways.
 - 3. Nonmetallic slotted support systems for communication raceways.
 - 4. Conduit and cable support devices.
 - 5. Support for conductors in vertical conduit.
 - 6. Structural steel for fabricated supports and restraints.
 - 7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 8. Fabricated metal equipment support assemblies.

1.3 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 the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for communications hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Aluminum slotted-channel systems.
4. Nonmetallic slotted-channel systems.
5. Equipment supports.
6. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for communications systems.

1. Include design calculations and details of trapeze hangers.
2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Ductwork, piping, fittings, and supports.
3. Structural members to which hangers and supports will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Projectors.

B. Seismic Qualification Certificates: For hangers and supports for communications equipment and systems, accessories, and components, 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.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer registered in North Carolina, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
 2. Component Importance Factor: 1.0.
- C. 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 Rating: Class 1.
 2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton business.
 - c. CADDY; a brand of nVent.
 - d. GS Metals Corp.
 - e. G-Strut.
 - f. Thomas & Betts Corporation; A Member of the ABB Group.
 - g. Unistrut; Part of Atkore International.
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 4. Channel Width: 1-1/4 inches Insert size.
 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 9. Channel Dimensions: Selected for applicable load criteria.
- B. Aluminum Slotted Support Systems: Extruded aluminum channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Industries, Inc.
 - b. Flex-Strut Inc.
 - c. Thomas & Betts Corporation; A Member of the ABB Group.
 - d. Unistrut; Part of Atkore International.
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Channel Material: 6063-T6 aluminum alloy.
 4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 5. Channel Width: 1-1/4 inches.
 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 9. Channel Dimensions: Selected for applicable load criteria.
- C. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) B-line, an Eaton business.
 - 2) Hilti, Inc.
 - 3) ITW Ramset/Red Head; Illinois Tool Works, Inc.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: Stainless-steel springhead type.
6. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. NECA/BICSI 568.
 3. TIA-569-D.
 4. NECA 101
 5. NECA 102.
 6. NECA 105.
 7. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, according to NFPA 70.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Use expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69 Spring-tension clamps.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment.

- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: 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. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 270536 – CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Ladder cable tray.
- 2. Wire-mesh cable tray.
- 3. Warning signs.

1.3 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.
- 2. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to sides of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

- C. Delegated-Design Submittal: For seismic restraints.

- 1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
- 2. Design Calculations: Calculate requirements for selecting seismic restraints.
- 3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.4 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. Scaled 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.
- B. Seismic Qualification Data: Certificates, for cable trays, accessories, and components, 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.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design cable tray supports and seismic bracing.
- B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.5.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 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.

2.3 LADDER CABLE TRAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Chatsworth
 2. B-line, an Eaton business.
 3. Cope Cable Tray; A Park of Atkore International.
 4. MonoSystems, Inc.
 5. MP Husky USA Cable Tray & Cable Bus.
- B. Description:
 1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
 2. Width: 18 inches unless otherwise indicated on Drawings.
 3. Minimum Usable Load Depth: 4 inches.
 4. Straight Section Lengths: 10 feet, except where shorter lengths are required to facilitate tray assembly.
 5. Rung Spacing: 9 inches o.c.
 6. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
 7. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
 8. No portion of the rungs shall protrude below the bottom plane of side rails.
 9. 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.
 10. Fitting Minimum Radius: 24 inches.
 11. Splicing Assemblies: Bolted type using serrated flange locknuts.
 12. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
- C. Materials and Finishes:
 1. Steel:

- a. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A1008/A1008M, Grade 33, Type 2.
- b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
- c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
- d. Finish: Hot-dip galvanized after fabrication, complying with ASTM A123/A123M, Class B2.
 - 1) Hardware: Galvanized, ASTM B633.
- e. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D769.

2.4 WIRE-MESH CABLE TRAY

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

1. Cooper Industries; Cooper B-Line; GS Metals Corp.
2. MonoSystems, Inc.
3. MP Husky USA Cable Tray & Cable Bus.

B. Description:

1. Configuration: Galvanized- steel wire mesh, complying with NEMA VE 1.
2. Width: 18 inches unless otherwise indicated on Drawings.
3. Minimum Usable Load Depth: 4 inches.
4. Straight Section Lengths: 10 feet, except where shorter lengths are required to facilitate tray assembly.
5. Structural Performance: 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.
6. Class Designation: Comply with NEMA VE 1, Class 10AA.
7. Splicing Assemblies: Bolted type using serrated flange locknuts.
8. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

C. Materials and Finishes:

1. Steel:
 - a. Straight Sections and Fittings: Steel complies with the minimum mechanical properties of ASTM A1008/A1008M, Grade 33, Type 2.
 - b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
 - c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
 - d. Finish: Electrogalvanized after fabrication, complying with ASTM B633.
 - 1) Hardware: Galvanized, ASTM B633.

- e. Finish: Epoxy-resin paint.
 - 1) Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
 - 2) Epoxy-Resin Topcoat: Epoxy, cold-cured gloss, MPI# 77.
 - 3) Hardware: Chromium-zinc plated, ASTM F1136.

2.5 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.6 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."

2.7 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA VE 2.
- 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 270529 "Hangers and Supports for Communications 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 VE 2. Do not install more than one cable tray splice between supports.
- M. Support wire-basket cable trays with wall brackets.
- N. Support center support hangers for wire-basket trays with 3/8-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 VE 2. 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.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Division 26 "Grounding and Bonding for Electrical Systems."
- B. Cable trays shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."
- 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."

3.3 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. In existing construction, remove inactive or dead cables from cable trays.

3.4 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.

3.5 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.

3.6 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 270536

SECTION 270544 – SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND 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. 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.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 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.

2.2 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, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. HOLDRITE.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 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.

2.3 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, provide products by the following:
 - a. HOLDRITE.

2.4 GROUT

- A. Description: Non-shrink; 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.

2.5 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.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 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.

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 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.

3.2 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.

3.3 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 271100 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

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. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Grounding.
- B. Related Requirements:
 - 1. Section 271313 "Communications Copper Backbone Cabling" for copper data cabling associated with system panels and devices.
 - 2. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.
- C. RCDD: Registered Communications Distribution Designer.

1.4 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.6 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 Commercial Installer, Level 2.
 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

2.1 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."
 1. Use fire-retardant paint to paint plywood. Keep any fire resistant labels unpainted and visible.
 2. Provide backboards around the equipment rooms.

2.2 19-INCH EQUIPMENT RACKS

- A. Description: Two- post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch equipment mounting with an opening of 17.72-inches between rails.
- B. Chatsworth CPI or approved equal.
- C. General Requirements:
 1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Material: Extruded aluminum.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
 4. Color: Black.
- D. Floor-Mounted Racks:
 1. Overall Height: 72 inches.

2. Overall Depth: 29 inches.
3. Two-Post Load Rating: 400 lb.
4. Number of Rack Units per Rack: 45.
 - a. Numbering: Every rack units, on interior of rack.
5. Threads: 12-24.
6. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
7. Base shall have a minimum of four mounting holes for permanent attachment to floor.
8. Top shall have provisions for attaching to cable tray or ceiling.
9. Self-leveling.

E. Cable Management:

1. Provide 6" double-sided vertical cable channel manager with covers on both sides of each rack.
2. Metal, with integral wire retaining fingers.
3. Baked-polyester powder coat finish.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.3 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. Cord connected with 15-foot 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.

2.4 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications 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.

2.5 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

3.1 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.

3.2 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.

3.3 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."

3.4 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.

3.5 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.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.6 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.
- D. Labels shall be preprinted or computer-printed type.

END OF SECTION

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DIVISION 28 FIRE ALARM SPECIFICATIONS
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<u>SECTION</u>	<u>TITLE</u>
283111	DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEMS

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SECTION 283111 – DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Magnetic door holders.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.
10. System printer.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 SUBMITTALS

- A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.

2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a) Trained and certified by manufacturer in fire-alarm system design.
 - b) NICET-certified fire-alarm technician, Level III minimum.
 - c) Licensed or certified by authorities having jurisdiction.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 2. Include voltage drop calculations for notification appliance circuits.
 3. Include power supply calculations. Provide 25% spare capacity on each power supply.
 4. Include battery-size calculations. Provide 25% spare capacity on each battery system.
 5. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 6. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- D. Complete drawings including the following shall be submitted by the contractor for the proposed system:
 1. Provided contractor provided usable electronic floor plan drawings in a usable format such as AutoCAD, floor plans shall be provided identifying all initiating, end of line, supervisory, indicating appliances, and output control devices; including circuit interface panels, annunciators, remote panels and the main CPU locations. Raceways shall be shown, with the size identified, the number of conductors with type and size, meeting the percentage of allowable National Electric Code fill used.
 2. Wiring diagrams showing points of connection and terminals used for all electrical connections to the system devices and panels.
- E. A complete proposed system database including a description of all logic strings, control by event programming and point identification labels on a CD" and in a formatted printed form, required for off site editing, uploading and downloading shall be submitted for evaluation by the owner. A

programming manual shall accompany the submitted program and shall be adequate to allow understanding, operation and editing by the system owner.

- F. Copies of required approved drawings by the “Authority Having Jurisdiction” (AHJ).
1. Prior to commencing with the installation of the fire alarm system, this contractor shall submit the plans for the fire alarm system to the local authority having jurisdiction for approval. This contractor shall pay all fees associated with this approval including the fee for all inspections. An original “Stamped Approved Drawing” along with the Fire Marshall’s inspection certificate shall be delivered to the building owner prior to submitting for final payment.
- G. Qualification Data: For qualified Installer.
- H. Field quality-control reports.
- I. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a) Frequency of testing of installed components.
 - b) Frequency of inspection of installed components.
 - c) Requirements and recommendations related to results of maintenance.
 - d) Manufacturer's user training manuals.
 5. Manufacturer's required maintenance related to system warranty requirements.
 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 7. Copy of NFPA 25.
- J. 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.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- 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. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 1. Notify Owner no fewer than two days in advance of proposed interruption of fire-alarm service.
 2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

1.8 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.9 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.10 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. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
 5. Keys and Tools: One extra set for access to locked and tamper proofed components.
 6. Audible and Visual Notification Appliances: One of each type installed.
 7. Fuses: Two of each type installed in the system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Siemens
 2. SimplexGrinnell LP; a Tyco International company.
 3. Notifier

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 1. Manual stations.
 2. Heat detectors.
 3. Smoke detectors.
 4. Duct smoke detectors.
 5. Verified automatic alarm operation of smoke detectors.

6. Automatic sprinkler system water flow.
 7. Heat detectors in elevator shaft and pit.
 8. Fire-extinguishing system operation.
 9. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
 2. Identify alarm at fire-alarm control unit and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Release fire and smoke doors held open by magnetic door holders.
 6. Activate voice/alarm communication system.
 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 9. Recall elevators to primary or alternate recall floors.
 10. Activate emergency lighting control.
 11. Activate emergency shutoffs for gas and fuel supplies.
 12. Record events in the system memory.
 13. Record events by the system printer.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Elevator shunt-trip supervision.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.

5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
 9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a) System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b) Include a real-time clock for time annotation of events on the event recorder and printer.
2. Addressable initiation devices that communicate device identity and status.
 - a) Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b) Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.

- a) Initiating Device Circuits: Style D.
 - (i) The system shall have an interconnecting riser loop or network (Style 6 supervision) for interconnection between fire alarm control panels and transponder panels.
 - b) Notification Appliance Circuits: Style Z.
 - (i) Submit Loading calculations for all Notification Appliance Circuits (NAC) complete with the spare capacities as identified herein. The maximum load on a single NAC shall not exceed 1.0 amperes. It shall be possible to install Audible Notification Appliances (Horns) and Visual Notification Appliances (Strobes) on the same circuit and maintain the ability to "Silence" the Audible Appliances while the Visual Appliances continue to "Flash". An NAC shall be zoned by "Level" or "Floor" and at no time be allowed to serve multiple "Levels" or "Floors".
 - c) Signaling Line Circuits: Style 6.
 - d) Install no more than 50 addressable devices on each signaling line circuit. Provide a minimum of one circuit per floor.
2. Serial Interfaces: Two RS-232 ports for printers.
- D. Smoke-Alarm Verification:
- 1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 - 2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
 - 3. Record events by the system printer.
 - 4. Sound general alarm if the alarm is verified.
 - 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- E. Notification Appliance Circuit: Operation shall sound in a temporal patten.
- F. Elevator Recall:
- 1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
 - a) Elevator lobby detectors except the lobby detector on the designated floor.
 - b) Smoke detector in elevator machine room.
 - c) Smoke detectors in elevator hoistway.
 - 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.

3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a) Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 1. Batteries: Sealed lead calcium. Provide 25% spare capacity on each battery system.
 2. The battery supply shall be calculated to operate its load in a supervisory mode for twenty-four (24) hours with no primary power applied and, after that time, operate in the alarm mode for five (5) minutes.
- M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show

visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a) Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
 - b) Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
 - c) Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

- a) Primary status.
 - b) Device type.
 - c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
- C. Ionization Smoke Detector:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a) Primary status.
 - b) Device type.
 - c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
- D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a) Primary status.
 - b) Device type.
 - c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
 4. Each sensor shall have multiple levels of detection sensitivity.

5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
- B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
- D. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 1. Rated Light Output:
 - a) 15, 30, 75, 110 or 177 cd, selectable in the field.

- b) As part of this contract the candela (cd) of the visual notification appliances shall be set as identified by Chapter 7 of NFPA 72 for the area of coverage at no time will the 15/75 cd comprise be allowed.
 - c) As part of one's submittal, floor drawings shall be provided identifying the candela of each appliance.
2. Mounting: Wall mounted unless otherwise indicated and "Listed" for such. Units shall be available for Ceiling Mounted and "Listed" for such applications. All appliances shall be semi-flush where ever possible with the manufacturer's prescribed surface back box at those locations identified on the contract drawings as surface mounted.
 3. Weatherproof Locations: Appliance shall be Listed for such applications and be complete with a Weatherproof Back Box.
 4. Provide wire guards as shown on the contract drawings to prevent physical damage. Light output ratings shall be determined with guards in place.
 5. Flashing shall be synchronized with other units.
 6. Strobe Leads: Factory connected to screw terminals.
 7. Mounting Faceplate: Factory finished white.
- E. Voice/Tone Notification Appliances (Speakers):
1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
 2. High-Range Units: Rated 2 to 15 W.
 3. Low-Range Units: Rated 1 to 2 W.
 4. Mounting: Semi-flush where ever possible with the manufacturer's prescribed surface back box at those locations identified on the contract drawings as surface mounted.
 5. Matching Transformers: Tap range matched to acoustical environment of speaker location.
 6. Provide wire guards as shown on the contract drawings to prevent physical damage.
 7. Weatherproof Locations: Appliance shall be Listed for such applications and be complete with a Weatherproof Back Box.

2.8 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.

3. Rating: 24-V ac or dc.

4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.9 REMOTE ANNUNCIATOR

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

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.

2. Programming device.

3. LED display.

4. Manual test report function and manual transmission clear indication.

5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 SYSTEM PRINTER

- A. Printer shall be listed and labeled by an NRTL as an integral part of fire-alarm system.

2.13 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

2.14 FIRE ALARM WIRE AND CABLE

- A. Fire Alarm Power Branch Circuits: Building wire as specified herein.

- B. Initiating, Signal Circuits, Data and 24 VDC Power Cables: Building wire as specified. Non-power limited, fire-protective signaling cable, copper conductor, 150 volt insulation rated 60 degree C; Power limited fire-protective signaling cable, copper conductor, 300 volts insulation rated 105 degree C.

1. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.
2. All fire alarm cable shall be installed in an "Approved" metallic clad raceway.
3. Wiring for the analog loop circuits and the network data circuits shall be 18 AWG twisted and shielded FPL type, West Penn Wire number 975.

4. Wiring for the visual appliances, audible appliances and remote annunciator power circuits shall be a 14 AWG type FPL, West Penn Wire number 994.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 72 inches above the finished floor. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 1. Install seismic bracing. Comply with requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
- D. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 1. Expand, modify, and supplement existing control equipment as necessary to extend existing monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
 2. Provide fiber optic interface between new building fire alarm control panel and existing building fire alarm control panel. Provide all parts necessary in existing building to upgrade the existing Simplex 4100U control panel for additional fiber optic connection to the new building, including communication cards, fiber optic interface cards, power supplies, etc.
- E. Smoke- or Heat-Detector Spacing:
 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 3. Smooth ceiling spacing shall not exceed 30 feet.

4. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
5. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- G. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- I. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- J. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.
- L. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- M. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- N. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 2. Alarm-initiating connection to elevator recall system and components.
 3. Alarm-initiating connection to activate emergency lighting control.

4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at elevator shunt trip breaker.
7. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
8. Supervisory connections at fire-pump engine control panel.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a) Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b) Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION

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