PROJECT MANUAL

BASIC SCIENCE BUILDING BS433
CLASSROOM RENOVATION

STATE PROJECT NO. H51-50052

SGA ARCHITECTURE
804 Meeting Street, Suite 103, Charleston SC, 29403
PHONE: 843-853-4506 | FAX: 843-853-4507 | WEBSITE: SGAarchitecture.com

MECHANICAL, PLUMBING, ELECTRICAL
RMF Engineering, Inc.
474 Wando Park Blvd.
Mount Pleasant, SC 29464
(843) 971-9639

April 21, 2017

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PROJECT NAME: Basic Science Building BS433 Classroom Renovation
PROJECT NUMBER: H51-50052
PROJECT LOCATION: Medical University of South Carolina, Charleston, SC

BID SECURITY REQUIRED? Yes ☒ No ☐ NOTE: Contractor may be subject to a performance appraisal at the close of the project.
PERFORMANCE BOND REQUIRED? Yes ☒ No ☐
PAYMENT BOND REQUIRED? Yes ☒ No ☐ CONSTRUCTION COST RANGE: $100,000 - 500,000

DESCRIPTION OF PROJECT: Renovation and expansion of existing tiered classroom into single level classroom of approximately 2,000 SF. Project includes selective demolition, metal framing and gypsum board walls and soffits, carpet tiles, acoustical wall panels, applied finishes, doors and windows, supporting mechanical and electrical work, and coordination with audio/visual installation by separate contractor.

BIDDING DOCUMENTS/PLANS MAY BE OBTAINED FROM:

PLAN DEPOSIT AMOUNT: $50.00 IS DEPOSIT REFUNDABLE? Yes ☐ No ☐ N/A ☒ Bidders must obtain Bidding Documents/Plans from the above listed source(s) to be listed as an official plan holder. Only those Bidding Documents/Plans obtained from the above listed source(s) are official. Bidders that rely on copies of Bidding Documents/Plans obtained from any other source do so at their own risk. All written communications with official plan holders & bidders WILL ☒ WILL NOT ☐ be via email or website posting.

IN ADDITION TO THE ABOVE OFFICIAL SOURCE(S), BIDDING DOCUMENTS/PLANS ARE ALSO AVAILABLE AT:

All questions & correspondence concerning this Invitation shall be addressed to the A/E.
A/E NAME: SGA Architecture
A/E CONTACT: Don E. Baus, AIA
A/E ADDRESS: Street/PO Box: 804 Meeting Street, Suite 103
City: Charleston State: SC ZIP: 29403-
EMAIL: Don@SGAArchitecture.com
TELEPHONE: 843.853.4506 FAX: 843.853.4507

AGENCY: Medical University of South Carolina
AGENCY PROJECT COORDINATOR: Wade Gatlin, AIA
ADDRESS: Street/PO Box: 97 Jonathan Lucas Street, MSC 190
City: Charleston State: SC ZIP: 29425-1900
EMAIL: gatlin@musc.edu
TELEPHONE: 843.792.2233 FAX: 843.792.1252

PRE-BID CONFERENCE: Yes ☒ No ☐ MANDATORY ATTENDANCE: Yes ☒ No ☐
PRE-BID DATE: 5/2/2017 TIME: 10:00 AM PLACE: 325 Calhoun Street, Rm RR 23, Charleston, SC
BID CLOSING DATE: 5/16/2017 TIME: 2:00 PM PLACE: 325 Calhoun Street, Rm RR 23, Charleston, SC

BID DELIVERY ADDRESSES:

HAND-DELIVERY:
Attn: Wade Lewis Gatlin, AIA
325 Calhoun Street, Room RR 23
Charleston, SC 29425

MAIL SERVICE:
Attn: Wade Lewis Gatlin, AIA / Attn: Debbie Zerba
325 Calhoun Street, Room RR 23, MSC 109
Charleston, SC 29425

IS PROJECT WITHIN AGENCY CONSTRUCTION CERTIFICATION? (Agency MUST check one) Yes ☒ No ☐

APPROVED BY: [Signature] (OSE Project Manager) DATE: 4/21/2017
The Form of the Instructions to Bidders shall be the SCOSE Version of the AIA Document A701-1997, “Instructions to Bidders” which is incorporated herein by reference. Samples of these documents may be viewed at

https://procurement.sc.gov/PS/vendor/PS-vendor-ose-news.phtm
BID SUBMITTED BY: ____________________________________________________________________________
(Bidder’s Name)

BID SUBMITTED TO: Medical University of South Carolina
(Owner’s Name)

FOR: PROJECT NAME: Basic Science Building BS433 Classroom Renovation
PROJECT NUMBER: H51-50052

OFFER

§ 1. In response to the Invitation for Construction Services and in compliance with the Instructions to Bidders for the above-named Project, the undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with the Owner on the terms included in the Bidding Documents, and to perform all Work as specified or indicated in the Bidding Documents, for the prices and within the time frames indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

§ 2. Pursuant to Section 11-35-3030(1) of the SC Code of Laws, as amended, Bidder has submitted Bid Security as follows in the amount and form required by the Bidding Documents:

☐ Bid Bond with Power of Attorney  ☐ Electronic Bid Bond  ☐ Cashier’s Check
(Bidder check one)

§ 3. Bidder acknowledges the receipt of the following Addenda to the Bidding Documents and has incorporated the effects of said Addenda into this Bid:

(Bidder, check all that apply. Note, there may be more boxes than actual addenda. Do not check boxes that do not apply)

ADDENDA: ☐ #1  ☐ #2  ☐ #3  ☐ #4  ☐ #5

§ 4. Bidder accepts all terms and conditions of the Invitation for Bids, including, without limitation, those dealing with the disposition of Bid Security. Bidder agrees that this Bid, including all Bid Alternates, if any, may not be revoked or withdrawn after the opening of bids, and shall remain open for acceptance for a period of 60 Days following the Bid Date, or for such longer period of time that Bidder may agree to in writing upon request of the Owner.

§ 5. Bidder herewith offers to provide all labor, materials, equipment, tools of trades and labor, accessories, appliances, warranties and guarantees, and to pay all royalties, fees, permits, licenses and applicable taxes necessary to complete the following items of construction work:

§ 6.1 BASE BID WORK (as indicated in the Bidding Documents and generally described as follows): Renovation and expansion of existing tiered classroom into single level classroom of approximately 2,000 SF. Project includes selective demolition, metal framing and gypsum board walls and soffits, carpet tiles, acoustical ceilings, acoustical wall panels, applied finishes, doors and windows, supporting mechanical and electrical work, and coordination with audio/visual installation by separate contractor.


(Bidder to insert Base Bid Amount on line above)
§ 6.2 BID ALTERNATES as indicated in the Bidding Documents and generally described as follows:

ALTERNATE # 1 (Brief Description):

☐ ADD TO or ☐ DEDUCT FROM BASE BID: $__

(Bidder to mark appropriate box to clearly indicate the price adjustment offered for each Alternate)

ALTERNATE # 2 (Brief Description):

☐ ADD TO or ☐ DEDUCT FROM BASE BID: $__

(Bidder to mark appropriate box to clearly indicate the price adjustment offered for each Alternate)

ALTERNATE # 3 (Brief Description):

☐ ADD TO or ☐ DEDUCT FROM BASE BID: $__

(Bidder to mark appropriate box to clearly indicate the price adjustment offered for each Alternate)

§ 6.3 UNIT PRICES:

BIDDER offers for the Agency’s consideration and use, the following UNIT PRICES. The UNIT PRICES offered by BIDDER indicate the amount to be added to or deducted from the CONTRACT SUM for each item-unit combination. UNIT PRICES include all costs to the Agency, including those for materials, labor, equipment, tools of trades and labor, fees, taxes, insurance, bonding, overhead, profit, etc. The Agency reserves the right to include or not to include any of the following UNIT PRICES in the Contract and to negotiate the UNIT PRICES with BIDDER.

<table>
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<tr>
<th>No.</th>
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<th>UNIT OF MEASURE</th>
<th>ADD</th>
<th>DEDUCT</th>
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<tbody>
<tr>
<td>1.</td>
<td>Demolition of CMU</td>
<td>SF</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>2.</td>
<td>Installation of new CMU</td>
<td>SF</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>3.</td>
<td>Firestopping of CMU</td>
<td>SF</td>
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<td>$</td>
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<td>SF</td>
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<td>$</td>
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<td>5.</td>
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<td>6.</td>
<td></td>
<td></td>
<td>$</td>
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§ 7. LISTING OF PROPOSED SUBCONTRACTORS PURSUANT TO SECTION 3020(b)(i), CHAPTER 35, TITLE 11 OF THE SOUTH CAROLINA CODE OF LAWS, AS AMENDED
(See Instructions on the following page BF-2A)

Bidder shall use the below-listed Subcontractors in the performance of the Subcontractor Classification work listed:

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<th>SUBCONTRACTOR'S PRIME CONTRACTOR'S NAME</th>
<th>SUBCONTRACTOR'S PRIME CONTRACTOR'S SC LICENSE NUMBER</th>
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**BASE BID**

**ALTERNATE #1**

**ALTERNATE #2**

**ALTERNATE #3**

If a Bid Alternate is accepted, Subcontractors listed for the Bid Alternate shall be used for the work of both the Alternate and the Base Bid work.
INSTRUCTIONS FOR
SUBCONTRACTOR LISTING

1. Section 7 of the Bid Form sets forth an Owner developed list of contractor/subcontractor specialties by contractor license category and/or subcategory for which bidder is required to identify the entity (subcontractor(s) and/or himself) Bidder will use to perform the work of each listed specialty.
   a. Column A: The Owner fills out this column, which identifies the contractor/subcontractor specialties for which the bidder must list either a subcontractor or himself as the entity that will perform this work. Subcontractor specialties are identified by contractor license categories or subcategories listed in Title 40 of the South Carolina Code of laws. Abbreviations of classifications to be listed after the specialty can be found at: [http://www.llr.state.sc.us/POL/Contractors/PDFFiles/CLBClassificationAbbreviations.pdf](http://www.llr.state.sc.us/POL/Contractors/PDFFiles/CLBClassificationAbbreviations.pdf). If the owner has not identified a specialty, the bidder does not list a subcontractor.
   b. Columns B and C: In these columns, the Bidder identifies the subcontractors it will use for the work of each specialty listed by the Owner in Column A. Bidder must identify only the subcontractor(s) who will perform the work and no others. Bidders should make sure that their identification of each subcontractor is clear and unambiguous. A listing that could be any number of different entities may be cause for rejection of the bid as non-responsive. For example, a listing of M&M without more may be problematic if there are multiple different licensed contractors in South Carolina whose names start with M&M.

2. Subcontractor Defined: For purposes of subcontractor listing, a subcontractor is an entity who will perform work or render service to the prime contractor to or about the construction site pursuant to a contract with the prime contractor. Bidder should not identify sub-subcontractors in the spaces provided on the bid form but only those entities with which bidder will contract directly. Likewise, do not identify material suppliers, manufacturers, and fabricators that will not perform physical work at the site of the project but will only supply materials or equipment to the bidder or proposed subcontractor(s).

3. Subcontractor Qualifications: Bidder must only list subcontractors who possess a South Carolina Contractor’s license with the license classification and/or subclassification identified by the Owner in the first column on the left. The subcontractor license must also be within the appropriate license group for the work of the specialty. If Bidder lists a subcontractor who is not qualified to perform the work, the Bidder will be rejected as non-responsive.

4. Use of Own forces: If under the terms of the Bidding Documents, Bidder is qualified to perform the work of a listed specialty and Bidder does not intend to subcontract such work but to use Bidder’s own employees to perform such work, the Bidder must insert its own name in the space provided for that specialty.

5. Use of Multiple Subcontractors:
   a. If Bidder intends to use multiple subcontractors to perform the work of a single specialty listing, Bidder must insert the name of each subcontractor Bidder will use, preferably separating the name of each by the word “and”. If Bidder intends to use both his own employees to perform a part of the work of a single specialty listing and to use one or more subcontractors to perform the remaining work for that specialty listing, bidder must insert his own name and the name of each subcontractor, preferably separating the name of each with the word “and”. Bidder must use each entity listed for the work of a single specialty listing in the performance of that work.
   b. Optional Listing Prohibited: Bidder may not list multiple subcontractors for a specialty listing, in a form that provides the Bidder the option, after bid opening or award, to choose to use one or more but not all the listed subcontractors to perform the work for which they are listed. A listing, which on its face requires subsequent explanation to determine whether it is an optional listing, is non-responsive. If bidder intends to use multiple entities to perform the work for a single specialty listing, bidder must clearly set forth on the bid form such intent. Bidder may accomplish this by simply inserting the word “and” between the names of each entity listed for that specialty. Agency will reject as non-responsive a listing that contains the names of multiple subcontractors separated by a blank space, the word “or”, a virgule (that is a /), or any separator that the Agency may reasonably interpret as an optional listing.

6. If Bidder is awarded the contract, bidder must, except with the approval of the Agency for good cause shown, use the listed entities to perform the work for which they are listed.

7. If bidder is awarded the contract, bidder will not be allowed to substitute another entity as subcontractor in place of a subcontractor listed in Section 7 of the Bid except for one or more of the reasons allowed by the SC Code of Laws.

8. Bidder’s failure to identify an entity (subcontractor or himself) to perform the work of a subcontractor specialty listed in the first column on the left will render the Bid non-responsive.
§ 8. LIST OF MANUFACTURERS, MATERIAL SUPPLIERS, AND SUBCONTRACTORS OTHER THAN SUBCONTRACTORS LISTED IN SECTION 7 ABOVE (FOR INFORMATION ONLY):

Pursuant to instructions in the Invitation for Construction Services, if any, Bidder will provide to Owner upon the Owner’s request and within 24 hours of such request, a listing of manufacturers, material suppliers, and subcontractors, other than those listed in Section 7 above, that Bidder intends to use on the project. Bidder acknowledges and agrees that this list is provided for purposes of determining responsibility and not pursuant to the subcontractor listing requirements of SC Code Ann § 11-35-3020(b)(i).

§ 9. TIME OF CONTRACT PERFORMANCE AND LIQUIDATED DAMAGES

a) CONTRACT TIME

Bidder agrees that the Date of Commencement of the Work shall be established in a Notice to Proceed to be issued by the Owner. Bidder agrees to substantially complete the Work within 120 Calendar Days from the Date of Commencement, subject to adjustments as provided in the Contract Documents.

b) LIQUIDATED DAMAGES

Bidder further agrees that from the compensation to be paid, the Owner shall retain as Liquidated Damages the amount of $500.00 for each Calendar Day the actual construction time required to achieve Substantial Completion exceeds the specified or adjusted time for Substantial Completion as provided in the Contract Documents. This amount is intended by the parties as the predetermined measure of compensation for actual damages, not as a penalty for nonperformance.

§ 10. AGREEMENTS

a) Bidder agrees that this bid is subject to the requirements of the laws of the State of South Carolina.

b) Bidder agrees that at any time prior to the issuance of the Notice to Proceed for this Project, this Project may be canceled for the convenience of, and without cost to, the State.

c) Bidder agrees that neither the State of South Carolina nor any of its agencies, employees or agents shall be responsible for any bid preparation costs, or any costs or charges of any type, should all bids be rejected or the Project canceled for any reason prior to the issuance of the Notice to Proceed.

§ 11. ELECTRONIC BID BOND

By signing below, the Principal is affirming that the identified electronic bid bond has been executed and that the Principal and Surety are firmly bound unto the State of South Carolina under the terms and conditions of the AIA Document A310, Bid Bond, included in the Bidding Documents.

ELECTRONIC BID BOND NUMBER: ______________________________________

SIGNATURE AND TITLE: ________________________________________________
SE-330
LUMP SUM BID FORM

CONTRACTOR'S CLASSIFICATIONS AND SUBCLASSIFICATIONS WITH LIMITATION

SC Contractor's License Number(s): ______________________________________

Classification(s) & Limits: _____________________________________________

Subclassification(s) & Limits: __________________________________________

By signing this Bid, the person signing reaffirms all representation and certification made by both the person signing and the Bidder, including without limitation, those appearing in Article 2 of the Instructions to Bidders, is expressly incorporated by reference.

BIDDER’S LEGAL NAME: ________________________________________________

ADDRESS: ____________________________________________________________

..............................................................................................................

TELEPHONE: __________________________________________________________

EMAIL: ______________________________________________________________

SIGNATURE: ___________________________ DATE: __________

PRINT NAME: _________________________________________________________

TITLE: _______________________________________________________________
PROGRAM OBJECTIVES

1. MUSC/MUHA has adopted the following objectives:

   A. To provide maximum practical opportunities for Minority and Women's Business Enterprises (MWBEs) to participate as suppliers and contractors for our organization.

   B. To support the economic development of both small business enterprises and the minority community.

   C. To provide Minorities and Women equal opportunities for participation in Capital Projects construction (additions, renovations and new construction), procurement, professional services, and system-wide purchasing contracts.

   D. To provide procedures that will enable MUSC/MUHA to fulfill the goals of the State that are related to equal employment opportunities and affirmative actions in its construction contracts.

   E. To provide procedures for determining and monitoring MWBE participation and compliance with MWBE requirements stated in the contract documents. Also, to provide procedures for the solution of complaints concerning discrimination against any businesses holding contracts with the MUSC/MUHA.

   F. To evaluate and report to the MWBE Small and Minority Business Advocate and to MUSC/MUHA the results of contract activity, subject to the provisions of the MWBE Program.

2. In order to accomplish the objectives of the MWBE Program, the following specific goals have been established:

   A. To increase buying activities with Minority and Women's Enterprises that have the capability of providing construction services necessary for MUSC/MUHA operations.

   B. To actively and diligently seek out Minority and Women's Enterprises who have the potential of becoming a source of construction services.

   C. To promote awareness of the MWBE Program throughout MUSC/MUHA and the Community.

   D. To assist in the development of Minority and Women's Business Enterprises to insure that maximum opportunities are given to actively compete for construction opportunities with MUSC/MUHA.
SECTION I

GUIDELINES FOR M/WBE PARTICIPATION IN CONSTRUCTION SERVICES

CONSTRUCTION

These guidelines are established to accomplish the goal of providing for minority participation in Single and Multi-Prime capital construction contracts. The Medical University of South Carolina shall have a verifiable percentage goal of participation by Minority and Women’s businesses in the total value of work for each project for which a contract is awarded. These guidelines are published to accomplish that end.

ITEM 1:

INTENT

It is the intent of these guidelines that the Medical University of South Carolina and the contractors and subcontractors performing construction contracts for the Medical University of South Carolina shall cooperate, and in good faith, do all things legal, proper and reasonable to achieve the verifiable goal of 12% for participation by Minority and Women’s businesses in each construction project. Nothing contained in these guidelines shall be considered to require awarding authorities to award contracts or to make purchases of materials or equipment from M/WBE contractors who do not submit the lowest responsive responsible bid or bids.

ITEM 2:

DEFINITIONS

1. **Affirmative Action** - A plan, or specific measurable steps, taken by an agency, business or individuals to fully involve Minority Business Enterprises and Women’s Business Enterprises in contracts and programs and to assure non-discrimination and equal opportunities in the performance of work, contracts, or any elements of a project administered by MUSC/MUHA Minority/Women’s Business Enterprise Program.

2. **Bidder/Participant/Offeror** - Any person, firm, partnership, corporation, association, or joint venture seeking to be awarded a public contract or subcontract.

3. **Contract** - A mutually-binding legal document which defines a business relationship or any modification at the level of performance which obligates the seller to furnish supplies, equipment, materials or services, knowledge in performing construction and procurements, and obligating the buyer to pay for services.

4. **Contractor** - Any person, firm, partnership, corporation, association, or joint venture that has been awarded a contract purchase or service agreement at any level with MUSC/MUHA or that has contracted with the Owner to perform construction work or repair.

5. **Discrimination** – Any action that distinguishes, differentiates, separates, or segregates one person or group from another, solely on the basis of age, race, religion, color, sex, national origin, handicap or veteran's status.

6. **Goal** - An objective, expressed numerically to evaluate the type and amount of contract awards and performance of Minority- and Women-owned business enterprises.

7. **Good-Faith Effort** - All activity performed by bidders to encourage the participation of minority and women’s enterprises (M/WBE) in contracts covered under this plan.

8. **Joint Venture** - A legal merger of two or more businesses (separately-owned firms) for the purpose of submitting a single bid, to carry out a single business enterprise for profit, for which purpose they combine their property, capital, efforts, skills or knowledge.

9. **MUSC** – Medical University of South Carolina
10. **MUHA – Medical University Hospital Authority**

11. **Minority (MBE)** - a person who is a citizen or lawful permanent resident of the United States and who is:
   
   - **African-American**, that is, a person having origins in any of the original racial groups in Africa;
   - **Hispanic**, that is, a person of Spanish or Portuguese culture with origins in Mexico, South or Central America, or the Caribbean Islands, regardless of race;
   - **Native-American**, that is, a person having origins in any of the original peoples of North America; or
   - **Asian-American**, that is, persons having origin in any of the countries of the Far East, Southeast Asia, or the Indian areas.

12. **Minority or Women's Business Enterprises-M/WBE** - a business enterprise owned and controlled at a minimum of 51% by one or more members of a group defined as a minority or as women. A business certified as a minority- or woman-owned enterprise will show evidence of ownership and management interests and the daily business operations are real and continuing, not created solely to meet the M/WBE requirements.

13. **Owner** – Medical University of South Carolina/Medical University Hospital Authority

14. **Owned and Controlled** - A business which is (1) a sole proprietorship legitimately owned by an individual who is a member of a minority and/or female, (2) a partnership or joint venture controlled by minorities and/or females, and in which at least 51% of the beneficial ownership interests legitimately are held by minorities and/or females, or (3) a corporation or other entity controlled by minorities and/or females, and in which at least 51% of the voting interests are legitimately held by minorities and/or females. In addition, these persons must control the management and operation of the business on a day-to-day basis.

15. **Subcontractor** - A firm under contract with the prime contractor for supplying materials or labor and materials and/or installations. The subcontractor may or may not provide materials in his subcontract. Work subcontracted in an emergency and which could not have been anticipated is excluded as a part of this program.

16. **Verifiable goal** – For purposes of the Single-Prime contracts, the advertising authority has adopted written guidelines specifying the actions that the prime contractor should consider taking to ensure a good-faith effort in the recruitment and selection of minority and women’s businesses for participation in contracts awarded; the required actions must be documented in writing by the contractor to the appropriate awarding authority.

**PART 3:**

**RESPONSIBILITIES**

1. **Medical University of South Carolina/Medical University Hospital Authority - Owner**

   MUSC/MUHA under the Single and Multi Prime contract system will be responsible for the following:

   - For contracts in excess of $500,000 estimated cost, notify Minority and Women’s Business firms within twenty-one (21) days prior to the bid opening through means of advertising in the *South Carolina Business Opportunities* of the opportunities. Advertisements will include:
     1. Project description and location;
     2. Locations where bidding documents may be reviewed;
     3. Name of a representative of the Owner who can be contacted during the advertising period to advise who the prospective bidders are;
     4. Date, time and location of the bid opening.
     5. Date, time and location of pre-bid conference, if scheduled. The twenty-one day advance time period may be reduced to ten days for contracts in the range of $100,000 to $500,000 in the estimated cost.

   - The pre-bid conference, if scheduled, is conducted by the representative of the Owner, and will be open to all known and anticipated prime contractors, subcontractors, material suppliers, and other bidders.
2. **Prime Contractor, Bidder or Offeror**

Prime Contractors under the Single and Multi-Prime contract system will be responsible for the following:

(a) Attend the scheduled mandatory pre-bid conference.
(b) Identify or determine those work areas of a subcontract where M/WBEs may have an interest in performing subcontract work.
(c) Submit, with the first application for payment, a description of the portion of the work to be executed by M/WBEs expressed as a percentage of the total contract price.
(d) If the Contractor elects to use a M/WBE firm that is not certified by the Governor’s Office of Small and Minority Business Assistance (OSMBA) the Contractor shall encourage the subcontractor to submit an application for certification within thirty (30) days of signing the Letter of Intent (Appendix II). If the firm does not submit an application within the specified time frame or fails to meet the certification criteria, the contract amount with that M/WBE firm will not be considered as M/WBE participation.
(e) Upon being named the apparent low bidder, the Bidder shall submit to the Project Manager their good faith backup documentation if they have not met their M/WBE goal.
(f) If, during the construction of a project, additional subcontracting opportunities become available, the prime or general contractors must make good-faith efforts to solicit sub-bids from M/WBEs.

3. **M/WBE Responsibilities**

M/WBE firms do not have to be certified to be listed on the bid documents; however, M/WBE firms that have been awarded contracts will not be credited towards MUSC/MUHA’s M/WBE Program unless they are certified with the Governor’s Office of Small and Minority Business Assistance (OSMBA).

(a) M/WBEs should make every effort to establish contacts and relationships with contractors for potential future business, including attending pre-bid conferences and subscribing to industry and trade journals.

(b) In addition, M/WBEs who are contacted by Owners or Bidders should respond promptly whether or not they wish to submit a bid. If an M/WBE firm is listed as a subcontractor or supplier, they will be responsible for completing a Letter of Intent (Appendix II) in a timely manner and returning it to the Prime Contractor.

(c) M/WBE who are not certified at the time the firm commits to provide services, should apply for certification with the Governor’s Office of Small and Minority Business Assistance (CSMBA) within thirty (30) days. If the M/WBE firm fails to submit an application within the specified time frame or if the M/WBE firm is not granted certification by the Certification Committee, that M/WBE firm’s contract dollars will not be counted as M/WBE participation.
SECTION II

M/WBE CONTRACT PROVISIONS

ITEM 1: PROVISIONS FOR CONSTRUCTION

A. APPLICATION:

The requirements of the MUSC/MUHA Minority and Women’s Business Enterprise (M/WBE) Provisions and Guidelines are hereby made a part of these contract documents. The requirements shall apply to all contractors regardless of ownership. Copies of the M/WBE Program may be obtained from the M/WBE Administrator, Engineering and Facilities, 97 Jonathan Lucas Street, P.O. Box 250190, Charleston, SC 29425.

B. M/WBE SUBCONTRACT GOALS:

The goals for participation by M/WBE as subcontractors on this project have been set at 12%.

The Bidder shall provide documented proof, with the first application for payment, in the form of Appendix I, M/WBE Utilization Commitment Form the percentage of M/WBE participation. Submit signed copies of Appendix II - Letters Of Intent to Perform as a Subcontractor, to the Project Manager.

C. COMPLIANCE DOCUMENTATION:

If the M/WBE subcontract goals are not achieved, the Bidder shall provide the following documentation to the Project Manager with the first application for payment:

1. M/WBE Utilization Commitment (Appendix I)

2. With the first pay application, the Bidder shall provide to the Project Manager signed Letters of Intent to Perform as a Subcontractor (Appendix II) for the M/WBE subcontractors listed on Appendix I.

3. After review of the Bidder’s Good Faith Efforts, the Bidder may request and be granted a Waiver of the M/WBE goals that have not been met for that particular project. A Waiver may be granted upon review of the Bidder’s documentation and determination that, in fact, a Good Faith Effort has been put forth.

NOTE: If the Bidder provides sufficient evidence on the M/WBE Utilization Commitment (Appendix I) that the goals have been met, or awards all subcontracts to M/WBEs, the Good Faith Efforts Documentation as listed above in #3 may not be required.
APPENDIX I
M/WBE UTILIZATION COMMITMENT FORM
FOR
CONSTRUCTION

We, ___________________________ (Bidder), do certify that on the ___________________________ (Project Name) we will expend a minimum of ____.% of the total dollar amount of the contract with Minority/Women Business Enterprises. M/WBEs will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.

If the bidder intends to subcontract, this form must be completed regardless of the amount of M/WBE participation attained.

<table>
<thead>
<tr>
<th>NAME OF FIRM</th>
<th>PHONE NUMBER</th>
<th>MBE OR WBE</th>
<th>Description of Work</th>
<th>Dollar Value</th>
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The undersigned will enter into a formal agreement with Minority/Women’s Firms for work listed in this schedule conditional upon execution of a contract with the MUSC/MUHA.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: ___________________________

(Name & Phone No. of Authorized Officer)

Signature: ___________________________

Title: ___________________________

APPENDIX I OR APPENDIX II MUST BE SUBMITTED WITH THE FIRST APPLICATION FOR PAYMENT
APPENDIX II
LETTER OF INTENT
TO
PERFORM AS A
SUBCONTRACTOR OR SUBCONSULTANT
(PROVIDE MATERIALS OR/& SERVICES)

PROJECT: ____________________________________________
(Project Name)

TO: __________________________________________________
(Name of Prime Bidder)

The undersigned intends to perform work in connection with the above project as

_____ Minority Business Enterprise       _____ Women’s Business Enterprise

_____ The M/WBE status of the undersigned is certified by the Governor’s Office of Small and Minority Business Assistance. Our M/WBE certification number is ____________________________.

_____ The M/WBE status of the undersigned is not certified by the Governor’s Office of Small and Minority Business Assistance. Our application was submitted on ____________________________.

The undersigned is prepared to perform the following described work or provide materials or services in connection with the above project (specify in detail particular work items, materials or services to be performed or provided) at the following price:

________________________________________________________

You have projected the following commencement date for such work, and the undersigned is projecting completion of such work as follows:

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<th>Items</th>
<th>Projected Commencement Date</th>
<th>Projected Completion Date</th>
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Subcontracting at any tier must be reported and is subject to all M/WBE compliance requirements. This form shall be used for M/WBE subcontracting at any level.

Date: __________________________
(Name & Phone No. of M/WBE Company)

_______________________________
(Name & Title of Authorized Office)

_______________________________
(Signature)

THE PRIME CONTRACTOR MUST GET THIS FORM COMPLETED BY THE M/WBE SUBCONTRACTORS

MUSC/MUHA
Rev. 10/14/08
APPENDIX III
MWBE DOCUMENTATION OF CONTRACT PAYMENTS FORM

Prime Contractor: 

Address & Phone: 

Project Name: 

Pay Application #: Period: 

The following is a list of payments made to Minority and Women Business Enterprises certified by the Governor’s Office of Small and Minority Business Assistance on this project for the above mentioned period.

<table>
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<tr>
<th>MWBE FIRM NAME</th>
<th>INDICATE MBE OR WBE</th>
<th>OSMBA CERTIFICATION</th>
<th>AMOUNT TO BE PAID THIS PERIOD</th>
<th>TOTAL PAYMENTS TO DATE</th>
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Date: ________________

Name of Authorized Officer

Signature

Title

SUBMIT WITH EACH PAY REQUEST & FINAL PAYMENT

MUSC/MUHA

Rev. 10/14/08
NOTE: THE LANGUAGE USED IN THIS DOCUMENT DOES NOT CREATE AN EMPLOYMENT CONTRACT BETWEEN THE EMPLOYEE AND THE MEDICAL UNIVERSITY OF SOUTH CAROLINA (MUSC). MUSC RESERVES THE RIGHT TO REVISE THE CONTENT OF THIS DOCUMENT, IN WHOLE OR IN PART. NO PROMISES OR ASSURANCES, WHETHER WRITTEN OR ORAL, WHICH ARE CONTRARY TO OR INCONSISTENT WITH THE TERMS OF THIS PARAGRAPH CREATE ANY CONTRACT OF EMPLOYMENT.

I. PURPOSE

MUSC is committed to promoting a healthy, tobacco-free environment for its employees, faculty, students, visitors and patients. The purpose of this policy is to provide a healthy environment, minimize the negative effects of passive smoke and tobacco use, maximize fire safety and promote wellness and good health habits within all MUSC facilities, including MUSC affiliates, and the surrounding campus.

II. POLICY

A. Covered Individuals

The provisions of this policy shall apply to all employees (including faculty and staff), patients, visitors, students, volunteers, contractors and vendors unless otherwise noted.
B. **Use of Tobacco Products**

The use of any tobacco product is prohibited in all buildings, grounds and spaces either leased or owned by the Medical University. The Human Resources Management Policy No. 49, Tobacco-Free Campus, includes, but is not limited to, offices, classrooms, laboratories, elevators, stairwells, restrooms, shuttle buses, shuttle bus stops, sidewalks, parking areas, meeting rooms, hallways, lobbies, and other common areas. The use of tobacco products in University owned, operated or leased vehicles is prohibited. Use of tobacco products is also prohibited in personal vehicles parked on MUSC property. The use of tobacco products is prohibited on all streets and sidewalks within the Medical District as defined by the City of Charleston ordinance (see map). MUSC also prohibits the use of tobacco products by staff on private properties adjacent to the Medical District without explicit approval from the property owner.

C. **List of Tobacco Products**

Tobacco products include, but are not limited to, cigarettes, cigars, pipes, chewing tobacco, e-cigarettes and other smokeless tobacco products.

III. **INFORMATION AND PROCEDURE**

A. **Faculty/Staff/Volunteers**

1. Faculty, staff and volunteers are expected to comply with the Tobacco-Free Campus Policy and assist with sharing information about the policy.

2. New employees and volunteers will be informed of the Tobacco-Free Campus Policy during orientation.

3. Enforcement of the policy rests with the appropriate supervisory staff, deans, department heads and administrative officials.

4. When employees or volunteers observe violations of the policy, they should politely remind the offender of the policy and request that they dispose of tobacco materials.

5. If the employee or volunteer continues to violate the policy, the location and time of the violation should be reported to the appropriate supervisory staff, dean, department head or administrative official. Human Resources Employee Relations may also be contacted to report violations.

6. Violation patterns will be assessed and appropriate action initiated. Employees who are found to be in violation will be disciplined in accordance with the Human Resources Policy No. 45, Disciplinary Action. Action may
range from written reprimand to termination. Refer to specific guidelines as outlined by MUSC, MUHA and UMA.

B. **Patients**

1. Faculty, staff and clinical staff with patient care responsibilities are responsible for communicating and ensuring compliance with the Tobacco-Free Campus Policy.

2. Upon admission/check-in, patients will be verbally informed of the policy and a copy will be provided upon request.

3. Patients violating MUSC’s policy will be asked to dispose of tobacco materials.

4. Tobacco replacement therapies, i.e. nicotine patch, nicotine gum, etc., may be prescribed by the patient’s physician.

C. **Visitors**

1. Visitors will be informed of the policy and asked to comply while they are on campus.

2. Signage will be posted throughout MUSC’s buildings and grounds; stating this facility is a tobacco-free campus.

3. All employees and volunteers are encouraged to assist with the education of visitors regarding the policy, using policy information cards, which will be made available.

4. Employees are expected to help enforce the policy with visitors by requesting that they dispose of tobacco materials and respect MUSC’s healthcare mission and tobacco-free campus.

5. If a visitor is observed repeatedly violating the policy after being advised of the policy, staff should note the location and time of the violation and contact their respective manager, Department of Public Safety or Medical Center Safety and Security, or Human Resources.
D. **Students**

1. New students will be informed of the Tobacco-Free Campus Policy during orientation.

2. Enforcement of the policy rests with the respective Dean’s office.

3. When students observe violations of the policy, they should remind their fellow students of the policy and ask them to dispose of the tobacco materials.

4. If the student continues to violate the policy, the location and time of the violation should be reported to the appropriate Dean’s office.

5. Violation patterns will be assessed and appropriate action initiated.

6. Affiliation agreements will include the Tobacco-Free Campus Policy so that students from other schools will be advised of the policy.

E. **Contractors/Vendors**

1. A provision will be inserted in all contracts, e.g. construction and/or maintenance, to prohibit the employees of contractors/vendors from using tobacco materials on property owned or leased by MUSC.

2. Failure by the contractor/vendor or their employees to comply with the provisions of this policy could result in the termination of the contract.

IV. **ENFORCEMENT**

A. The monitoring and enforcement of this policy is the responsibility of ALL MUSC/ MUHA/UMA employees, students and volunteers. Each individual should consistently and politely bring any infraction of this policy to the attention of the person or persons observed violating the policy.

B. The MUSC Department of Public Safety and Medical Center Safety and Security will assist in the enforcement of this policy by reporting violations to the appropriate manager or supervisor. Employees are also expected to assume leadership roles by adhering to the policy provisions and by reminding others who aren’t in compliance of the policy provisions.

C. MUSC will provide Tobacco-Free Campus Policy information cards to facilitate the education and enforcement of the policy.

V. **RESOURCES**
MUSC will offer resources and support to tobacco users in abstaining from tobacco use on campus and in supporting users who desire to quit using tobacco. Smoking cessation classes and other tobacco education related resources or programs will be offered periodically for MUSC employees. Many of these programs are offered at little to no cost. Additional resources are outlined on the Tobacco-Free Campus website.

VI. EXCEPTIONS

Individuals enrolled in smoking research and/or treatment programs are permitted to smoke in designated smoking areas that are physically separated from care, treatment and service areas upon approval. If the Medical Center decides that patients may smoke in specific circumstances, it will designate smoking areas that are physically separated from care, treatment and service areas.

<table>
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<tr>
<th>Approved by:</th>
<th>Information Contact</th>
<th>Approved</th>
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<tr>
<td>Lisa P. Montgomery</td>
<td>Director of Human Resources Management</td>
<td>November, 2011</td>
</tr>
<tr>
<td>Vice President for Finance &amp; Administration</td>
<td>Effective</td>
<td>March 1, 2012</td>
</tr>
</tbody>
</table>
KEY:

- **MUSC Tobacco-Free Campus**
- **MUSC Tobacco-Free streets and sidewalks**
- **City of Charleston Smoke-Free Medical District streets and sidewalks**
- **Roper Hospital Tobacco-Free Campus**
The Form of the Contract shall be the SCOSE Version of the AIA Document A101-2007, Standard Form of Agreement Between Owner & Contractor where the basis of payment is a Stipulated Sum, which is incorporated herein by reference. Samples of these documents may be viewed at

The Form of the General Conditions shall be the SCOSE Version of the AIA Document A201-2007, “General Conditions of the Contract for Construction” which is incorporated herein by reference. Samples of these documents may be viewed at

https://procurement.sc.gov/PS/vendor/PS-vendor-ose-news.phtm
KNOW ALL MEN BY THESE PRESENTS, that (Insert full name or legal title and address of Contractor)

Name: 
Address: 

hereinafter referred to as “Contractor”, and (Insert full name and address of principal place of business of Surety)

Name: 
Address: 

hereinafter called the “surety”, are jointly and severally held and firmly bound unto (Insert full name and address of Agency)

Name: Medical University of South Carolina
Address: 97 Jonathan Lucas Street
Charleston, SC 29425

hereinafter referred to as “Agency”, or its successors or assigns, the sum of ______________________ ($_______), being the sum of the Bond to which payment to be well and truly made, the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated ______________ entered into a contract with Agency to construct

State Project Name: Basic Science Building BS433 Classroom Renovation
State Project Number: H51-50052

Brief Description of Awarded Work, as found on the SE-330 or SE-332, Bid Form: Renovation and expansion of existing tiered classroom into single level classroom of approximately 2,000 SF. Project includes selective demolition, metal framing and gypsum board walls and soffits, carpet tiles, acoustical ceilings, acoustical wall panels, applied finishes, doors and windows, supporting mechanical and electrical work, and coordination with audio/visual installation by separate contractor.

in accordance with Drawings and Specifications prepared by (Insert full name and address of A/E)

Name: SGA Architecture
Address: 804 Meeting Street, Suite 103
Charleston, SC 29403

which agreement is by reference made a part hereof, and is hereinafter referred to as the Contract.

IN WITNESS WHEREOF, Surety and Contractor, intending to be legally bound hereby, subject to the terms stated herein, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent or representative.

DATED this __________ day of __________, 2016  BOND NUMBER __________________________

(shall be no earlier than Date of Contract)

CONTRACTOR

By: ____________________________ (Seal)
Print Name: ____________________________
Print Title: ____________________________
Witness: ____________________________

SURETY

By: ____________________________ (Seal)
Print Name: ____________________________
Print Title: ____________________________
Witness: ____________________________

(Attach Power of Attorney)

(Additional Signatures, if any, appear on attached page)
NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Agency for the full and faithful performance of the contract, which is incorporated herein by reference.

2. If the Contractor performs the contract, the Surety and the Contractor have no obligation under this Bond, except to participate in conferences as provided in paragraph 3.1.

3. The Surety's obligation under this Bond shall arise after:

3.1 The Agency has notified the Contractor and the Surety at the address described in paragraph 10 below, that the Agency is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If the Agency, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive the Agency's right, if any, subsequently to declare a Contractor Default; or

3.2 The Agency has declared a Contractor Default and formally terminated the Contractor's right to complete the Contract.

4. If the Surety shall, within 15 days after receipt of notice of the Agency's declaration of a Contractor Default, and at the Surety's sole expense, take one of the following actions:

4.1 Arrange for the Contractor, with consent of the Agency, to perform and complete the Contract; or

4.2 Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

4.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Agency for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by the Agency and the contractor selected with the Agency's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the Bonds issued on the Contract, and pay to the Agency the amount of damages as described in paragraph 7 in excess of the Balance of the Contract Sum incurred by the Agency resulting from the Contractor Default; or

4.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and:

4.4.1 After investigation, determine the amount for which it may be liable to the Agency and, within 60 days of waiving its rights under this paragraph, tender payment thereof to the Agency; or

4.4.2 Deny liability in whole or in part and notify the Agency, citing the reasons therefore.

5. Provided Surety has proceeded under paragraphs 4.1, 4.2, or 4.3, the Agency shall pay the Balance of the Contract Sum to either:

5.1 Surety in accordance with the terms of the Contract; or

5.2 Another contractor selected pursuant to paragraph 4.3 to perform the Contract.

5.3 The balance of the Contract Sum due either the Surety or another contractor shall be reduced by the amount of damages as described in paragraph 7.

6. If the Surety does not proceed as provided in paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond 15 days after receipt of written notice from the Agency to the Surety demanding that the Surety perform its obligations under this Bond, and the Agency shall be entitled to enforce any remedy available to the Agency.

6.1 If the Surety proceeds as provided in paragraph 4.4 and the Agency refuses the payment tendered or the Surety has denied liability, in whole or in part, then without further notice the Agency shall be entitled to enforce any remedy available to the Agency.

6.2 Any dispute, suit, action or proceeding arising out of or relating to this Bond shall be governed by the Dispute Resolution process defined in the Contract Documents and the laws of the State of South Carolina.

7. After the Agency has terminated the Contractor's right to complete the Contract, and if the Surety elects to act under paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Agency shall be those of the Contractor under the Contract, and the responsibilities of the Agency to the Surety shall those of the Agency under the Contract. To a limit of the amount of this Bond, but subject to commitment by the Agency of the Balance of the Contract Sum to mitigation of costs and damages on the Contract, the Surety is obligated to the Agency without duplication for:

7.1 The responsibilities of the Contractor for correction of defective Work and completion of the Contract; and

7.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under paragraph 4; and

7.3 Damages awarded pursuant to the Dispute Resolution Provisions of the Contract. Surety may join in any Dispute Resolution proceeding brought under the Contract and shall be bound by the results thereof; and

7.4 Liquidated Damages, or if no Liquidated Damages are specified in the Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. The Surety shall not be liable to the Agency or others for obligations of the Contractor that are unrelated to the Contract, and the Balance of the Contract Sum shall not be reduced or set-off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Agency or its heirs, executors, administrators, or successors.

9. The Surety hereby waives notice of any change, including changes of time, to the contract or to related subcontracts, purchase orders and other obligations.

10. Notice to the Surety, the Agency or the Contractor shall be mailed or delivered to the address shown on the signature page.

11. Definitions

11.1 Balance of the Contract Sum: The total amount payable by the Agency to the Contractor under the Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts to be received by the Agency in settlement of insurance or other Claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Contract.

11.2 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform the Contract or otherwise to comply with the terms of the Contract.
SE-357
LABOR & MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that (Insert full name or legal title and address of Contractor)

Name: __________________________________________________________
Address: ________________________________________________________

hereinafter referred to as “Contractor”, and (Insert full name and address of principal place of business of Surety)

Name: __________________________________________________________
Address: ________________________________________________________

hereinafter called the “surety”, are jointly and severally held and firmly bound unto (Insert full name and address of Agency)

Name: Medical University of South Carolina
Address: 97 Jonathan Lucas Street
          Charleston, SC 29425

hereinafter referred to as “Agency”, or its successors or assigns, the sum of ______________ ($_____), being the
sum of the Bond to which payment to be well and truly made, the Contractor and Surety bind themselves, their heirs,
executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated ______________ entered into a contract with Agency to construct
State Project Name: Basic Science Building BS433 Classroom Renovation
State Project Number: H51-50052
Brief Description of Awarded Work, as found on the SE-330 or SE-332, Bid Form: Renovation and expansion of existing tiered classroom into single level classroom of approximately 2,000 SF. Project includes selective demolition, metal framing and gypsum board walls and soffits, carpet tiles, acoustical ceilings, acoustical wall panels, applied finishes, doors and windows, supporting mechanical and electrical work, and coordination with audio/visual installation by separate contractor.
in accordance with Drawings and Specifications prepared by (Insert full name and address of A/E)
Name: SGA Architecture
Address: 804 Meeting Street, Suite 103
          Charleston, SC 29403
which agreement is by reference made a part hereof, and is hereinafter referred to as the Contract.

IN WITNESS WHEREOF, Surety and Contractor, intending to be legally bound hereby, subject to the terms stated
herein, do each cause this Labor & Material Payment Bond to be duly executed on its behalf by its authorized officer, agent
or representative.

DATED this __________ day of __________, 20____
(shall be no earlier than Date of Contract)    BOND NUMBER __________________________

CONTRACTOR                      SURETY
By: ____________________________   By: ____________________________
(Seal)                          (Seal)
Print Name: ____________________________   Print Name: ____________________________
Print Title: ____________________________   Print Title: ____________________________
(Attach Power of Attorney)
Witness: ____________________________   Witness: ____________________________
(Additional Signatures, if any, appear on attached page)

1 of 2
NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Agency to pay for all labor, materials and equipment required for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to the Agency, this obligation shall be null and void if the Contractor:
   2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants; and
   2.2 Defends, indemnifies and holds harmless the Agency from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Contract.

3. With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.

4. With respect to Claimants, and subject to the provisions of Title 29, Chapter 5 and the provisions of §11-35-3030(2)(c) of the SC Code of Laws, as amended, the Surety’s obligation under this Bond shall arise as follows:
   4.1 Every person who has furnished labor, material or rental equipment to the Contractor or its subcontractors for the work specified in the Contract, and who has not been paid in full therefore before the expiration of a period of ninety (90) days after the date on which the last of the labor was done or performed by him or material or rental equipment was furnished or supplied by him for which such claim is made, shall have the right to sue on the payment bond for the amount, or the balance thereof, unpaid at the time of institution of such suit and to prosecute such action for the sum or sums justly due him.
   4.2 A remote claimant shall have a right of action on the payment bond upon giving written notice by certified or registered mail to the Contractor within ninety (90) days from the date on which such person did or performed the last of the labor or furnished or supplied the last of the material or rental equipment upon which such claim is made.
   4.3 Every suit instituted upon a payment bond shall be brought in a court of competent jurisdiction for the county or circuit in which the construction contract was to be performed, but no such suit shall be commenced after the expiration of one year after the day on which the last of the labor was performed or material or rental equipment was supplied by the person bringing suit.

5. When the Claimant has satisfied the conditions of paragraph 4, the Surety shall promptly and at the Surety’s expense take the following actions:
   5.1 Send an answer to the Claimant, with a copy to the Agency, within sixty (60) days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.
   5.2 Pay or arrange for payment of any undisputed amounts.
   5.3 The Surety’s failure to discharge its obligations under this paragraph 5 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a claim. However, if the Surety fails to discharge its obligations under this paragraph 5, the Surety shall indemnify the Claimant for the reasonable attorney’s fees the Claimant incurs to recover any sums found to be due and owing to the Claimant.

6. Amounts owed by the Agency to the Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any Performance Bond. The Contractor furnishing and the Agency accepting this Bond, they agree that all funds earned by the contractor in the performance of the Contract are dedicated to satisfy obligations of the Contractor and the Surety under this Bond, subject to the Agency’s prior right to use the funds for the completion of the Work.

7. The Surety shall not be liable to the Agency, Claimants or others for obligations of the Contractor that are unrelated to the Contract. The Agency shall not be liable for payment of any costs or expenses of any claimant under this bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

8. The Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.

9. Notice to the Surety, the Agency or the Contractor shall be mailed or delivered to the addresses shown on the signature page.

10. By the Contractor furnishing and the Agency accepting this Bond, they agree that this Bond has been furnished to comply with the statutory requirements of the South Carolina Code of Laws, as amended, and further, that any provision in this Bond conflicting with said statutory requirements shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

11. Upon request of any person or entity appearing to be a potential beneficiary of this bond, the Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

12. Any dispute, suit, action or proceeding arising out of or relating to this Bond shall be governed by the laws of the State of South Carolina.

13. DEFINITIONS
   13.1 Claimant: An individual or entity having a direct contract with the Contractor or with a Subcontractor of the Contractor to furnish labor, materials, or equipment for use in performance of the Contract. The intent of this Bond shall be to include without limitation in the terms “labor, materials or equipment” that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of the Contractor and the Contractor’s Subcontractors, and all other items for which a mechanic’s lien might otherwise be asserted.

   13.2 Remote Claimant: A person having a direct contractual relationship with a subcontractor of the Contractor or subcontractor, but no contractual relationship expressed or implied with the Contractor.

   13.3 Contract: The agreement between the Agency and the Contractor identified on the signature page, including all Contract Documents and changes thereto.
### Change Order to Construction Contract

**Agency:** Medical University of South Carolina  
**Project Name:** Basic Science Building BS433 Classroom Renovation  
**Project Number:** H51-50052

**Contractor:**  
**Contract Date:**

This Contract is changed as follows: (Insert description of change in space provided below)

#### Adjustments in the Contract Sum:

1. Original Contract Sum: $0.00
2. Change in Contract Sum by previously approved Change Orders:  
3. Contract Sum prior to this Change Order: $0.00
4. Amount of this Change Order:  
5. New Contract Sum, including this Change Order: $0.00

#### Adjustments in the Contract Time:

1. Original Substantial Completion Date:  
2. Sum of previously approved increases and decreases in Days: Days
3. Change in Days for this Change Order: Days
4. New Substantial Completion Date:

**Contractor Acceptance:**

BY: ____________________________ Date: ____________  
(Signature of Representative)  
Print Name: ______________________

**A/E Recommendation for Acceptance:**

BY: ____________________________ Date: ____________  
(Signature of Representative)  
Print Name: ______________________

**Agency Acceptance and Certification:**

BY: ____________________________ Date: ____________  
(Signature of Representative)  
Print Name: ______________________

Change is within Agency Construction Contract Change Order Certification of: $___________  
Yes ☐  No ☐

Office of the State Engineer Authorization for change exceeding Agency Construction Contract Change Order Certification:

**Authorized By:** ____________________________  
(OSE Project Manager)  
**Date:** ____________

**SUBMIT THE FOLLOWING TO OSE:**

1. SE-380, fully completed and signed by the Contractor, A/E and Agency;
2. Detailed back-up information from the Contractor/Subcontractor(s) that justifies the costs and schedule changes shown.
3. If any item exceeds Agency certification, OSE will authorize the SE-380 and return to Agency.
SECTION 011000 - SUMMARY

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Work by Owner.
   4. Work under separate contracts.
   5. Owner-furnished products.
   6. Access to site.
   7. Occupancy requirements.
   8. Work restrictions.

1.3 PROJECT INFORMATION
A. Project Identification: Basic Sciences Building BS433 Classroom Renovation.
B. Owner: Medical University of South Carolina.
C. Architect: SGA Architecture, 804 Meeting Street, Suite 103, Charleston, SC 29403.

1.4 WORK COVERED BY CONTRACT DOCUMENTS
A. The Work of Project is defined by the Contract Documents and consists of the following:
   1. Renovation and expansion of existing tiered classroom into single level classroom of approximately 2,000 SF. Project includes selective demolition, metal framing and gypsum board walls and soffits, carpet tiles, acoustical ceilings, acoustical wall panels, applied finishes, doors and windows, supporting mechanical and electrical work, and coordination with audio/visual installation by separate contractor.

B. Type of Contract:
   1. Project will be constructed under a single prime contract.
1.5 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

B. Work by Owner: Owner will perform the following construction operations at Project site. Those operations may be scheduled to be substantially complete before work under this Contract begins, conducted simultaneously with work of this Contract, or will be performed subsequent to work of this Contract, as directed by Owner.

1. Removal of miscellaneous wall-mounted items including but not limited to paper towel dispensers, soap dispensers, needle disposal units, light boxes, signage, toilet tissue dispensers, message boards, clocks, televisions, television brackets, etc.

1.6 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors performing work for Owner on site, so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1. Audiovisual coordination and installation.

1.7 OWNER-FURNISHED PRODUCTS

A. Owner may furnish various products and equipment. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.

1.8 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways, parking garage, loading areas, and entrances serving premises clear and available to Owner, Owner’s employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

   a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.9 OCCUPANCY REQUIREMENTS
A. Full Owner Occupancy: Owner will occupy site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations.

1.10 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours of 8:00 AM to 5:00 PM, Monday through Friday, except otherwise indicated.

1. The building can also be made available on weekends and during evening hours upon coordination and approval from MUSC. Classes are held year round. During the general course of the construction/demolition, any work (including use of saws, hammers, drills or impact tools) that generates a sound level greater than 50 decibels will require coordination with MUSC to be performed after business hours. The Contractor must use noise restrictions when determining his schedule. No additional time will be granted for not meeting this requirement.
2. Existing Corridors: No tool or equipment storage permitted in existing corridors.
3. Utility Shutdowns: Provide at least 7 calendar days notice to Owner.
4. Cleaning after Trash Removal: Trash containers must be covered when removing debris from building. No mopping necessary. When corridors are used for trash removal, damp mop corridor after every trash trip.
5. Tacky Mats: Change tacky mats at least twice a day, or when dirty to the point of not working effectively.
6. The Contractor may not use the existing toilet areas as work or clean-up areas for personnel or equipment.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than 7 calendar days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

C. Cutting into Existing Concrete Slabs: Prior to core drilling or other penetration of existing concrete slab, perform full scan using ground penetrating radar or X-ray technology to determine location of reinforcement and other critical elements within slab.

D. Debris Removal: Debris removal will be limited to before 7 AM in the morning and after 5 PM in the afternoon. Coordinate debris removal with Owner's representative, using only the designated route.

E. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

F. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes. Smoking is only permitted in designated smoking areas.

G. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
H. Employee Identification: Owner will provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times. Failure to wear visible MUSC identification may result in personnel being removed from site.

I. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 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 published as part of the U.S. National CAD Standard and scheduled on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01100
SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General Conditions as modified by the Owner and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes administrative and procedural requirements for unit prices.
   B. Related Requirements:
      1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS
   A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES
   A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
   B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
   C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
   D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1 – Demolition of CMU:
   1. Description: Demolish concrete masonry units at top of existing corridor walls. Amount of 500 SF is to be included in Base Bid. Unit prices will be used for additions or deductions to that amount.
   2. Unit of Measurement: Square Foot.

B. Unit Price No. 2 – Installation of New CMU:
   1. Description: Purchase and install new concrete masonry units at top of existing corridor walls. Amount of 1000 SF is to be included in Base Bid. Unit prices will be used for additions or deductions to that amount.
   2. Unit of Measurement: Square Foot.

C. Unit Price No. 3 – Firestopping of CMU:
   1. Description: Provide firestopping and fire-resistive joint sealing as required for concrete masonry at corridor walls. Amount of 1200 SF is to be included in Base Bid. Unit prices will be used for additions or deductions to that amount.
   2. Unit of Measurement: Square Foot.

D. Unit Price No. 4 – Leveling of Concrete Slab:
   1. Description: Provide hydraulic-cement-based underlayment for use below VCT, as specified in Section 035416 – Hydraulic Cement Underlayment. Amount of 2000 SF (at ½-inch thickness) is to be included in Base Bid. Unit prices will be used for additions or deductions to that amount.
   2. Unit of Measurement: Square Foot.

END OF SECTION 012200
PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK
A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS
A. Owner-Initiated Proposal Requests: Architect 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. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within 10 days 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.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes 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 Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use forms provided by Owner.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Contractor will submit a Change Order for signatures of Owner and Architect.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600
SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 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.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule. Cost-loaded CPM Schedule may serve to satisfy requirements for the Schedule of Values.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
   a. Application for Payment forms with Continuation Sheets.
   b. Submittals Schedule.
   c. 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.

3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the 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. Name of Architect.
   c. Contractor's name and address.
   d. Date of submittal.

2. Submit draft of AIA Document G703 Continuation Sheets.

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. Change Orders (numbers) that affect value.
d. Dollar value.

1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items under required principal subcontracts for operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training in the amount of 5 percent of the Contract Sum.

5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

6. 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. If specified, include evidence of insurance or bonded warehousing.

7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

8. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

9. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

10. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

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 of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

3. Include Project Number, Project Name, Cost Center, and Purchase Order Number on all applications for payment.

E. Transmittal: Submit 3 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.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

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 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 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 waivers of lien on forms, executed in a manner acceptable to Owner.

G. 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.


5. List of Contractor's staff assignments.

H. Application for Payment at Substantial Completion: After issuing 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.

2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."


3. AIA Document G707, "Consent of Surety to Final Payment."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)
SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Administrative and supervisory personnel.
2. Project meetings.

1.3 COORDINATION

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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

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 and activities of other contractors 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.
9. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.4 SUBMITTALS

A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key and sub-key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

B. All Contractors, sub-contractors and other workers associated with accomplishing the Work are required to get a Construction Identification Badge, prior to coming to construction site. This badge shall be worn at all times when present at the site. See attached Badge Request Form at the end of this section. The completed Badge Request Form must be returned to the Project Manager at least two days prior to person needing access to site.

1.6 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.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: 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 a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. **Attendees:** Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All 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. Phasing.
   b. Critical work sequencing and long-lead items.
   c. Designation of key personnel and their duties.
   d. Procedures for processing field decisions and Change Orders.
   e. Procedures for requests for interpretations (RFIs).
   f. Procedures for testing and inspecting.
   g. Procedures for processing Applications for Payment.
   h. Distribution of the Contract Documents.
   i. Submittal procedures.
   j. Use of the premises and existing building.
   k. Work restrictions.
   l. Owner's occupancy requirements.
   m. Construction waste management and recycling.
   n. Parking availability.
   o. Office, work, and storage areas.
   p. Equipment deliveries and priorities.
   q. Security.
   r. Progress cleaning.
   s. Working hours.

3. **Minutes:** Record and distribute meeting minutes.

C. **Progress Meetings:** Conduct progress meetings at bi-weekly intervals, unless other arrangements are made in advance with Project Manager and Architect. Coordinate dates of meetings with preparation of payment requests.

1. **Attendees:** In addition to representatives of Owner 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 conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. **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) Status of submittals.
      2) Access.
      3) Site utilization.
      4) Temporary facilities and controls.
      5) Work hours.
      6) Progress cleaning.
      7) Status of correction of deficient items.
3. Minutes: Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
   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

Attachment: Application for MUSC Construction Identification Badge
APPLICATION FOR MUSC CONSTRUCTION IDENTIFICATION BADGES

The following information is to be provided by the prime contractor for each employee, subcontractor(s), vendor or anyone contracted by them to be on the construction site that are required for the completion of the contract documents. The contractor is to submit this information to the MUSC Project Manager, 97 Jonathan Lucas Street, Charleston, South Carolina, or via facsimile at 843-792-0251. After the information is entered into the Identity Management Database, the contractor will be notified to contact Public Safety, 101 Doughty Street, Charleston, South Carolina, via facsimile at 843-792-6650, for scheduling of the time for the photograph identification badges to be issued. It will be the responsibility of the prime contractor to insure that all employees are wearing current badges. Anyone without a badge will be required to leave the site immediately. Public Safety will inspect for proper identification routinely and violators will be removed from the site. It will be the responsibility of the individual to replace any badges that are lost or stolen. The prime contractor at the completion of the project will return all badges to Public Safety. Please telephone Public Safety at 843-792-4023 should you have questions.

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<td>Employee Date of Birth:</td>
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| Employee Signature: |  |
SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
      1. Contractor's Construction Schedule.
      2. Submittals Schedule.

1.3 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 activities are activities on the critical path. They must start and finish on the planned early start and finish times.
      2. Predecessor activity is an activity that must be completed before a given activity can be started.
   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 when activities can be performed and the critical path of Project.
   C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.
   D. Event: The starting or ending point of an activity.
   E. Float: The measure of leeway in starting and completing an activity.
      1. Float time belongs to Owner.
      2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
      3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
   F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
   G. Major Area: A story of construction, a separate building, or a similar significant construction element.
H. Milestone: A key or critical point in time for reference or measurement.

I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.4 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. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect's final release or approval.

C. Contractor's Construction Schedule: Submit three printed copies and one electronic copy of initial schedule, large enough to show entire schedule for entire construction period.

D. CPM Reports: Concurrent with CPM schedule, submit three printed copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float.

1. Activity Report: List of all 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 all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS
2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by the construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
2. Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. 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.

C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for long lead 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. 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.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
3. Owner-Furnished Products: Include coordination of OFOI, OFCI and OFVI equipment.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery dates. Delivery dates indicated stipulate the earliest possible delivery date.
5. Work Restrictions: Show the effect of the following items on the schedule:
   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use of premises restrictions.
   g. Seasonal variations.
h. Environmental control.

6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Mockups.
   e. Fabrication.
   f. Sample testing.
   g. Deliveries.
   h. Installation.
   i. Tests and inspections.
   j. Adjusting.
   k. Curing.
   l. Startup and placement into final use and operation.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

1. Refer to Division 01 Section "Payment Procedures" for cost reporting and payment procedures.

G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

H. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules, as approved by Owner.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Preliminary Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 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 CPM network analysis diagram.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary 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. Purchase of materials.
   c. Delivery.
   d. Fabrication.
   e. Installation.

2. Processing: Process data to produce output data or 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.

3. 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. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal 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.
8. Total float or slack time.
10. Dollar value of activity (coordinated with the Schedule of Values).

F. 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.
5. Changes in the critical path.
6. Changes in total float or slack time.

G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
   a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
   b. Submit value summary printouts one week before each regularly scheduled progress meeting.
PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At bi-weekly 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. Include coordination of OFOI, OFCI, and OFVI equipment.
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 Actual Completion percentage for each activity.

B. 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.

END OF SECTION 013200
PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

1.3 DEFINITIONS
A. Action Submittals: Written and graphic information that requires Architect's responsive action.
B. Informational Submittals: Written information that does not require Architect's approval. Submittals may be rejected for not complying with requirements.

1.4 CAD DRAWINGS
A. General: Electronic copies of CAD Drawings of the Contract Drawings may be provided by the Architect for Contractor's use in preparing submittals for a nominal fee, at Architect’s option.

1.5 SUBMITTAL PROCEDURES
A. 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. 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 reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 21 days for initial review of each submittal.

3. Direct Transmittal to Consultant: Where the Contract Documents indicate that submittals may be transmitted directly to Architect's consultants, provide duplicate copy of transmittal to Architect. Submittal will be returned to Architect before being returned to Contractor.

4. If intermediate submittal is necessary, process it in same manner as initial submittal.

5. Allow 15 days for processing each resubmittal.

6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

D. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.

2. Provide a space approximately 4 by 5 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.

3. Include the following information on label for processing and recording action taken:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name and address of Contractor.
   e. Name and address of subcontractor.
   f. Name and address of supplier.
   g. Name of manufacturer.
   h. Unique identifier, including revision number.
   i. Number and title of appropriate Specification Section.
   j. Drawing number and detail references, as appropriate.
   k. Other necessary identification.

E. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.

   1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.

   2. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.

G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.

   1. Provide separate transmittal for each specification section submittal. Provide complete submittals to include all items required in the submittal paragraphs of each specification section. Partial submittals will be returned without review unless prior approval has been received for partial submittal.

   2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and
deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.

3. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.

4. Transmittal Form: Use AIA Document G810, or other Owner-approved form.

H. Distribution: Furnish copies of final submittals to Owner, manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

1. Provide Owner's copy of final submittals in electronic form.

I. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

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 printed 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 written recommendations.
   b. Manufacturer's product specifications.
   c. Manufacturer's installation instructions.
   d. Standard color charts.
   e. Manufacturer's catalog cuts.
   f. Wiring diagrams showing factory-installed wiring.
   g. Printed performance curves.
   h. Operational range diagrams.
   i. Mill reports.
   j. Standard product operating and maintenance manuals.
   k. Compliance with recognized trade association standards.
   l. Compliance with recognized testing agency standards.
   m. Application of testing agency labels and seals.
   n. Notation of coordination requirements.

4. Number of Copies: Submit one electronic copy and four print copies. Mark up and retain one returned copy as a Project Record Document.

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: Include the following information, as applicable:

   a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
f. Shopwork manufacturing instructions.
g. Templates and patterns.
h. Schedules.
i. Design calculations.
j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.

2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.

4. Number of Copies: Submit copies of each submittal, as follows:
   a. Initial Submittal: Submit one electronic copy and four print copies. Architect will return the marked-up print. Send on copy to Owner for review purposes at same time.
   b. Final Submittal: Submit four print copies, unless prints are required for operation and maintenance manuals. Submit six prints where prints are required for operation and maintenance manuals. Architect will retain two prints; remainder will be returned. Mark up and retain one returned print as a Project Record Drawing.

D. Coordination Drawings: Comply with requirements in Division 01 Section "Project Management and Coordination."

E. Samples: Prepare physical units of materials or products, including the following:

1. Comply with requirements in Division 01 Section "Quality Requirements" for mockups.
2. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the 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.
3. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
   a. Generic description of Sample.
   b. Product name or name of manufacturer.
   c. Sample source.
4. Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, provide the following:
   a. Size limitations.
   b. Compliance with recognized standards.
   c. Availability.
   d. Delivery time.
5. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three sets of paired units that show approximate limits of the variations.
b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.

6. Number of Samples for Verification: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.

   a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

7. 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.

F. Product Schedule or List: 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.
   2. Number and name of room or space.
   3. Location within room or space.

G. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation."

H. 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, and telephone number 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.

2.2 INFORMATIONAL SUBMITTALS

   A. General: Prepare and submit Informational Submittals required by other Specification Sections.

      1. Number of Copies: Submit two print copies and one electronic copy of each submittal, unless otherwise indicated. Architect will not return copies.
      2. Certificates and Certifications: Provide a notarized 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.
      3. Test and Inspection Reports: Comply with requirements in Division 01 Section "Quality Requirements."

   B. Contractor's Construction Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation."
C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Certificates: Prepare written statements on qualified entity’s letterhead certifying that individual or product complies with requirements and, where required, is authorized for this specific Project.

E. Test Reports: Prepare reports written by a qualified entity, indicating and interpreting results of tests performed on product, for compliance with performance requirements.

F. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 01 Section “Closeout Procedures.”

G. Design Data: Prepare 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.

H. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.

I. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections.

J. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

K. Material Safety Data Sheets: Submit information directly to Owner. If submitted to Architect, Architect will not review this information but will return it with no action taken.

1. Contractor shall maintain an up-to-date set of MSDS on construction site for review by Owner at any time.

PART 3 - EXECUTION

3.1 CONTRACTOR’S REVIEW

A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. 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 ACTION
A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. Approved: Where submittals are marked "Approved," that part of Work covered by submittal may proceed provided it complies with requirements of Contract Documents; final acceptance will depend upon that compliance.

2. Approved as Noted: When submittals are marked "Approved as Noted," that part of Work covered by submittal may proceed provided it complies with notations or corrections on submittal and requirements of Contract Documents; final acceptance will depend on that compliance.

3. Revise and Resubmit: When submittal is marked "Revise and Resubmit," do not proceed with that part of Work covered by submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare new submittal in accordance with notations; resubmit without delay. Repeat if necessary to obtain different action mark.

4. Other Action: Where submittal is primarily for information or record purposes, special processing or other activity, submittal will be returned, marked "Not Reviewed".

C. Informational Submittals: Architect will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 013300
SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting 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-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.

D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 REGULATORY REQUIREMENTS

A. Copies of Regulations: Obtain copies of the applicable regulations and retain at Project site to be available for reference by parties who have a reasonable need.

1.5 SUBMITTALS
A. Qualification Data: 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. Description of test and inspection, including identification as Typical or Special.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number 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.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.
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.

D. Permits, Licenses, and Certificates: For Owner's records, 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.

E. Detailed Coordination Drawings: Detailed plans and sections drawn to scale and coordinating work of all trades. Show the following:

1. Dimensionally correct information, color coded by trades, in CADD composite overlay format.
2. Sections indicating critical ceiling heights.
3. Overhead-mounted items including mechanical, electrical and plumbing components; speakers; sprinklers; hangers, structural supports, penetrations, and other junctures of ceilings with adjoining construction.
4. Minimum Drawing Scale: ¼ inch per foot.
5. Sign-off by trade representative.

1.6 QUALITY ASSURANCE

A. 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.
B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, 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.

D. 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.

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 are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E548, and that specializes in types of tests and inspections to be performed.

H. Preconstruction Testing: Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.

1. Contractor responsibilities include the following:
   a. Provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Fabricate and install test assemblies using installers who will perform the same tasks for Project.
   d. When testing is complete, remove assemblies; do not reuse materials on Project.

2. 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.

I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
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.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Owner will engage a qualified testing agency to perform tests and inspections.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders, or by Owner if no allowance is specified for project.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
4. Contractor must coordinate all Owner-engaged testing and inspection services within the Contractor’s project work schedule.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. 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.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
2. Test and balance of HVAC is Contractor's responsibility.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting 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 inspecting 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. 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. Perform training on equipment or component operation.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.


1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location 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 any duties of Contractor.

F. Associated Services: Cooperate with agencies 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 inspecting. 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 inspecting 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 inspecting.

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. Submit schedule within 30 days of date established for the Notice to Proceed.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections attached to this Section, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect 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 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 ABOVE-CEILING INSPECTION

A. Prior to installation of ceiling systems, Architect and Engineer will conduct an above-ceiling completion inspection. The purpose of this inspection is to verify the following:

1. Suspended ceiling system and seismic support are complete.
2. Electrical work above ceiling is complete.
3. HVAC and other mechanical/plumbing work above ceiling is complete.
4. Insulation, fireproofing and firestopping (where applicable) above ceiling are complete.
5. Fire and smoke rated construction above ceiling is satisfactory.
6. Fire rated construction designations marked above ceilings are satisfactory.
7. That all above ceiling work is complete to the status where only service or maintenance type work remains to be done above the ceiling. Architect may designate sections of the project to be inspected or may require 100% prior to performing the inspection.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.
2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

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 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. Water Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

B. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.5 QUALITY ASSURANCE


1.  Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.

2.  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.

1.6 PROJECT CONDITIONS

A. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.

2.2 EQUIPMENT

A. General: Provide equipment suitable for use intended.

B. Field Offices: Owner will designate space to be used as construction office.

C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

D. 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 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.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures."

E. 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 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.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
3.2 TEMPORARY UTILITY INSTALLATION

A. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

B. Sanitary Facilities: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

1. Contractor may NOT use toilets as work or clean-up areas for personnel or equipment.

C. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide negative air pressure in all construction areas prior to the beginning of the Work, unless otherwise approved in writing by Owner.

D. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

E. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.

F. Emergency Egress Lighting and Lighted Exit Signs: Within construction area, provide temporary emergency egress lighting with battery backup to ensure safe egress from construction site. Provide adequate temporary Emergency Exit signs, lit with battery backup to ensure egress paths are well marked.

G. Telephone Service: Provide temporary telephone service or coordinate with Owner for use of telephone throughout construction period for common-use facilities used by all personnel engaged in construction activities.

H. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
   a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
   b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.

3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.3 SUPPORT FACILITIES INSTALLATION
A. General: Comply with the following:

1. Locate temporary construction and support facilities for easy access.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion.

B. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 01 Section "Execution Requirements" for progress cleaning requirements.

1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.

C. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

D. Existing Elevator Use: Use of Owner's existing elevators will be permitted, as long as elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing interior finishes, 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.

E. Existing Stair Usage: Use of Owner's existing stairs will be permitted, as long as stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If, despite such protection, stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

1. Provide negative pressure machines in all construction areas to limit dust and dirt migration into occupied patient areas.
2. Construct or repair all partitions that enclose construction areas prior to starting demolition work. Enclosing partitions shall extend to the underside and be sealed to the structural deck above to limit dust, dirt and noise migration into adjacent occupied areas.
B. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

C. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

D. 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 not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

2. Vertical Openings: Close openings of 25 sq. ft. or less with fire-retardant treated plywood or similar non-combustible materials.

3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, framed construction.

E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise. Contractor is responsible for keeping adjacent hallways free from dust and debris.

1. Temporary Plastic Partitions: Construct dustproof, floor-to-structural deck partitions (unless authorized to extend to ceiling in writing by Owner) of non-combustible framing members and fire-retardant treated polyethylene sheets. Cover floor with 2 layers of 6-mil polyethylene sheets, extending sheets 18 inches up the side walls. Overlap and tape full length of joints.

2. Temporary Fire-Rated Partitions: Construct dustproof, floor-to-structural deck partitions (unless authorized to extend to ceiling in writing by Owner) of non-combustible framing members and gypsum board on both sides of framing, of sufficient thickness to maintain fire rating equivalent to existing construction. Cover floor with 2 layers of 3-mil polyethylene sheets, extending sheets 18 inches up the side walls. Overlap and tape full length of joints.

3. Insulate partitions to provide noise protection to occupied areas.

4. Seal joints and perimeter. Equip partitions with dustproof doors or zippers, latching devices and security locks.

5. Protect air-handling equipment.

6. Weatherstrip openings.

7. Provide walk-off mats at each entrance through temporary partition.
   a. Walk-Off Mats: “Tacky Mats” by Lab Safety Supply, P.O. Box 1368, Janesville, WI (1-800-356-0783).

F. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Do NOT initiate hot work unless a Hot Work Permit for the specific work area has been issued and is valid.

2. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
   a. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
3. Store combustible materials in containers in fire-safe locations.
4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
5. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
6. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
7. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
8. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 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. Protect from damage caused by freezing temperatures and similar elements.

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. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. 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 the property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 01 Section "Closeout Procedures."

END OF SECTION 015000
SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. SC Law Section 11-35-20, to foster effective broad-based competition for public procurement within the free enterprise system, applies to this Section.

C. SC Law Section 11-35-2730, requiring that all specifications be written to be nonrestrictive and to assure cost effective procurement , applies to this Section.

D. SC Law Section 11-35-2750, requiring that specifications prepared by architects and engineers shall be nonrestrictive and shall maximize cost effectiveness of all procurements, applies to this Section.

1.2 SUMMARY

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

1.3 DEFINITIONS

A. Products: Items purchased 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.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
2. Form: Tabulate information for each product under the following column headings:
a. Specification Section number and title.
b. Generic name used in the Contract Documents.
c. Proprietary name, model number, and similar designations.
d. Manufacturer's name and address.
e. Supplier's name and address.
f. Installer's name and address.
g. Projected delivery date or time span of delivery period.
h. Identification of items that require early submittal approval for scheduled delivery date.

3. Completed List: Within 21 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.

4. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.

1.5 SUBSTITUTIONS

A. Substitution Requests: Submit three copies of each request for consideration. Identify 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 included in Project Manual or CSI standard form.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
   a. Statement indicating why specified material or product cannot be provided.
   b. Coordination information, including a list of changes or modifications 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 substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
   e. Samples, where applicable or requested.
   f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
   g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
   h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
   i. Detailed comparison of Contractor's Construction Schedule using proposed substitution 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 lack of availability or delays in delivery.
   j. Cost information, including a proposal of change, if any, in the Contract Sum.
   k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
   l. 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.

B. Basis-of-Design Product Specification Submittal:
1. Submit request for Substitution in the form and manner specified above for substitutions. Submit detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

2. The Architect is the sole judge of aesthetics.

C. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week 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 7 days of receipt of additional information or documentation, whichever is later.

1. Form of Acceptance: Change Order.
2. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

1.6 QUALITY ASSURANCE

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

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

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 ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage.
10. Protect all building materials from becoming wet during delivery, installation and storage to prevent possible mold growth and product integrity issues.

B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.8 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.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
   3. Refer to Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that 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 not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Architect will make selection.
   5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
   7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures: Procedures for product selection include the following:
   1. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   2. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   3. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
2.2 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

B. 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:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. 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.

2.3 COMPARABLE PRODUCTS

A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.
SECTION 017000 – EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. General installation of products.
2. Coordination of Owner-installed products.
3. Progress cleaning.
4. Starting and adjusting.
5. Protection of installed construction.
6. Correction of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of utilities and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Acceptance of Conditions: 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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

   a. Description of the Work.
   b. List of detrimental conditions, including substrates.
   c. List of unacceptable installation tolerances.
   d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls and floors for suitable conditions where products and systems are to be installed.
5. 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 and Owner 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. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect and Owner not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's written permission.

C. 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.

D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

3.3 INSTALLATION

A. General: 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 8 feet in spaces without a suspended ceiling.

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 the best possible results. 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.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
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.

G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.


2. Do not hold materials more than 7 days during normal weather or 3 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.

B. 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.

C. 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.

D. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

E. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

F. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

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 assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.5 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

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: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.6 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. Comply with manufacturer's written instructions for temperature and relative humidity.

3.7 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017000
SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes procedural requirements for cutting and patching.

1.3 DEFINITIONS
A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE
A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
   1. Prior to core drilling or other penetration of existing concrete slab, perform full scan using ground penetrating radar or X-ray technology to determine location of reinforcement and other critical elements within slab.
B. 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, but are not limited to, the following:
   1. Primary operational systems and equipment.
   2. Air or smoke barriers.
   3. Fire-protection systems.
   4. Control systems.
   5. Communication systems.
   6. Conveying systems.
   7. Electrical wiring systems.
C. Miscellaneous Elements: Do not cut and patch the following elements or related 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.
   1. Water, moisture, or vapor barriers.
   2. Membranes and flashings.
   3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces 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.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing 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.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

3.3 PERFORMANCE

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 existing 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. Cutting: Cut existing 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 as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. 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.
5. Proceed with patching after construction operations requiring cutting are complete.

C. 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 possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate 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.
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 existing 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, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang existing 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.

END OF SECTION 017329
SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Project Record Documents.
3. Operation and maintenance manuals.
4. Warranties.
5. Instruction of Owner's personnel.
6. Final cleaning.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, and similar final record information.
4. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
5. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
6. Complete startup testing of systems.
7. Submit test/adjust/balance records.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
10. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
11. Complete final cleaning requirements, including touchup painting.
12. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion (SE-550) 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. Reinspection: 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.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies 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. Use CSI Form 14.1A or other Architect approved form.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, 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.
   d. Name of Contractor.
   e. Page number.

1.5 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. When the Contractor believes his work is complete, he shall submit SE-560 “Certificate of Final Completion” to Architect and request final inspection. Upon receipt of SE-560, Architect shall:
   a. Survey the work to verify that project is ready for final inspection.
   b. If Architect disagrees with Contractor’s assessment of status of project, Architect will notify Contractor accordingly.
   c. If Architect agrees with Contractor’s assessment of status of project, schedule final completion inspection, with the Agency and Contractor.

2. Architect will perform final completion inspection, along with those attending the inspection and, if the results are acceptable, Architect and Agency will sign SE-560 and declare that the project is finally complete.

1.6 CONTRACT CLOSURE AND FINAL PAYMENT

A. Closure of the construction contract, including final payment to the Contractor, requires the following:

1. A declaration of Final Completion issued by Architect and accepted by the Agency.
2. Contractor’s submission, to Architect, of the following:
CLOSEOUT PROCEDURES
BSB BS433 Classroom Renovation
State Project No. H51-50052
04/21/2017

1.7 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.

1. 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 prepare the marked-up Record Prints.
   a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
   b. Accurately record information in an understandable drawing technique.
   c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
   d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

3. Mark important additional information that was either shown schematically or omitted from original Drawings.

4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.

5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy 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. Note related Change Orders, Record Drawings, and Product Data, where applicable.

D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.

E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:
   a. Emergency instructions and procedures.
   b. System, subsystem, and equipment descriptions, including operating standards.
   c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
   d. Description of controls and sequence of operations.
   e. Piping diagrams.

2. Maintenance Data:
   a. Manufacturer's information, including list of spare parts.
   b. Name, address, and telephone number of Installer or supplier.
   c. Maintenance procedures.
   d. Maintenance and service schedules for preventive and routine maintenance.
   e. Maintenance record forms.
   f. Sources of spare parts and maintenance materials.
   g. Copies of maintenance service agreements.
   h. Copies of warranties and bonds.

B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.9 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

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 DEMONSTRATION AND TRAINING

A. Instruction: Instruct Owner’s personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Provide instructors experienced in operation and maintenance procedures.
2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
3. Schedule training with Owner, through Architect, with at least seven days’ advance notice.
4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:

1. System design and operational philosophy.
2. Review of documentation.
3. Operations.
4. Adjustments.
5. Troubleshooting.
7. Repair.
3.2 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. All trash and debris must be in enclosed, sealed bins to prevent dust/debris spillage in adjacent areas.

C. 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 portion of Project:
   a. Remove tools, construction equipment, machinery, and surplus material from Project site.
   b. Remove debris and surface dust from limited access spaces, including plenums, shafts, trenches, equipment vaults, and similar spaces.
   c. Sweep concrete floors broom clean in unoccupied spaces.
   d. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
   e. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
   f. Remove labels that are not permanent.
   g. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
   h. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   i. Replace parts subject to unusual operating conditions.
   j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
   k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   l. Clean ducts, blowers, and coils if units were operated without filters during construction.
   m. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
   n. Leave Project clean and ready for occupancy.

D. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

E. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700
PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes the following:
1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

B. Related Sections include the following:
1. Division 01 Section "Summary" for use of premises, phasing, work restrictions, minimization of noise and Owner-occupancy requirements.
2. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
3. Division 01 Section "Cutting and Patching" for cutting and patching procedures.

1.3 DEFINITIONS
A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP
A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

B. Items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.
1.5 SUBMITTALS

A. Qualification Data: For demolition firm.

B. Schedule of Selective Demolition Activities: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
   2. Interruption of utility services. Indicate how long utility services will be interrupted.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Use of elevator and stairs.
   5. Locations of proposed dust- and noise-control temporary partitions and means of egress.
   6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
   7. Means of protection for items to remain and items in path of waste removal from building.

C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

D. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
   5. Review areas where existing construction is to remain and requires protection.

1.7 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
1. Comply with requirements specified in Division 01 Section "Summary."

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs.

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
   1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
   2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
      a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
   3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
   4. Cover and protect furniture, furnishings, and equipment that have not been removed.
   5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of selective demolition.
3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner’s storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition, cleaned and reinstalled in their original locations after selective demolition operations are complete.
3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Existing Construction to Be Removed: As indicated on Drawings.

B. Existing Items to Be Removed and Reinstalled: As indicated on Drawings.

C. Existing Items to Be Removed and Turned over to Owner: As indicated on Drawings.

D. Existing Items to Remain: As indicated on Drawings.

END OF SECTION 024119
SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

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 hydraulic-cement-based underlayment for use below interior floor coverings.
   B. Related Sections include the following:
      1. Division 09 Sections for patching and leveling compounds applied with floor coverings.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: Plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.
   C. Manufacturer Certificates: Signed by manufacturers of both underlayment and floor covering system certifying that products are compatible.
   D. Qualification Data: For Installer.
   E. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE
   A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.
   B. Product Compatibility: Manufacturers of both underlayment and floor covering system certify in writing that products are compatible.
   C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.
1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature and humidity, ventilation, and other conditions affecting underlayment performance.

1. Place hydraulic-cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

1.7 COORDINATION

A. Coordinate application of underlayment with requirements of floor covering products, including adhesives, specified in Division 09 Sections, to ensure compatibility of products.

PART 2 - PRODUCTS

2.1 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

A. Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thicknesses of 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Ardex; K-15 Self-Leveling Underlayment Concrete.
   c. L&M Construction Chemicals, Inc.; Levelex.
   d. Maxxon Corporation; Level-Right.

2. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.

3. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than 70 deg F.

D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance.
   1. Proceed with application only after unsatisfactory conditions have been corrected.

B. Substrate Tolerances: Check existing slabs for flatness.
   1. Check and measure existing slab surfaces to verify that gap at any point between concrete surface and an unleveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8 inch.

3.2 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.
   1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
   2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
   1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

C. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.

D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.
   1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
   2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
   3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply underlayment to produce uniform, level surface.
1. Apply a final layer without aggregate to produce surface.
2. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035416
SECTION 042000 - UNIT MASONRY

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 unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).
2. Mortar and grout.
3. Reinforcing steel.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Miscellaneous masonry accessories.

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths ($f'_m$) at 28 days.

B. Determine net-area compressive strength ($f'_m$) of masonry by testing masonry prisms according to ASTM C 1314.

1.5 SUBMITTALS

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

B. Samples for Verification: For each type and color of the following:

1. Accessories embedded in masonry.

C. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.
2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
7. Anchors, ties, and metal accessories.
D. **Mix Designs:** For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.6 **QUALITY ASSURANCE**

A. **Fire-Resistance Ratings:** Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

1.7 **DELIVERY, STORAGE, AND HANDLING**

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 **PROJECT CONDITIONS**

A. **Protection of Masonry:** During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

B. **Stain Prevention:** Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

PART 2 - PRODUCTS

2.1 **MASONRY UNITS, GENERAL**

A. **Defective Units:** Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
2. Weight Classification: Medium weight, unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect’s sample.
5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.3 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
3. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units where indicated.
5. Shall meet the Seismic Performing Requirements for seismic design Category "D" per ACI 530 latest addition.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

2.5 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.
B. Hot-Dip Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60, commercial-quality, steel sheet zinc coated by hot-dip process on continuous lines before fabrication.

D. Steel Sheet, Galvanized after Fabrication: ASTM A 366/A 366M cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153.

E. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
   c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
   d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.7 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

   1. Do not use calcium chloride in mortar or grout.
   2. Use portland cement-lime or mortar cement mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

   1. For interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
D. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.  
   2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.  
   3. All reinforced cells shall be filled with 3,000 psi grout, at a minimum.  
   4. All lintels shall be filled with 3,000 psi grout.

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 the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
   2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
   4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
   5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
   3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
   4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
   3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
   4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes, including epoxy paint.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.
E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL JOINTS

A. General: Install control joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete or masonry lintels where shown and where openings of more than 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.11 REPAIRING AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleared for comparison purposes. Obtain Architect’s approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
   a. If necessary, only with written approval from masonry and mortar manufacturers, clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 042000
SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

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. Plastic laminate shelving.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, including finishing materials and processes.

B. Samples for Verification:
   1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.

1.4 QUALITY ASSURANCE

A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork 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. Field Measurements: Where woodwork is 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 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Products: Comply with the following:

1. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

2.2 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood 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 nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Contact Adhesive: 250 g/L.

2.3 FABRICATION, GENERAL

A. Interior Woodwork Grade: Provide Premium grade interior woodwork complying with the referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated.

D. Complete fabrication, including assembly and finishing, 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.

2.4 SHELVING

A. Exposed Shelving: Made from the following material, 3/4 inch thick.
1. High-pressure decorative laminate, Grade HGS, on core of veneer core plywood or medium-density fiberboard.
2. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of substrate.

B. Colors, Patterns, and Finishes: As selected by Architect.

C. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; powder-coat-finished steel.

D. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.

B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

3.3 SHELVING INSTALLATION

A. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

B. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches o.c. and within 6 inches of end of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

C. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.
   1. Fasten shelves to cleats with finish nails or trim screws, set flush.
   2. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.
3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean woodwork on exposed surfaces.

END OF SECTION 064023
SECTION 078413 – PENETRATION FIRESTOPPING

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 firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:

1. Walls and partitions.

1.3 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide firestop 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 assembly penetrated.

1. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.

B. F-Rated Systems: Provide firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

1. Penetrations located outside wall cavities.
2. Penetrations located outside fire-resistive shaft enclosures.
3. Penetrations located in construction containing fire-protection-rated openings.
4. Penetrating items larger than 4-inch-diameter nominal pipe or 16 sq. in. in overall cross-sectional area.

D. For firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant firestop systems.
2. For penetrations involving insulated piping, provide firestop systems not requiring removal of insulation.

E. For firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.
1.4 SUBMITTALS

A. Product Data: For each type of firestop system product indicated.

B. 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.

C. Product Certificates: Signed by manufacturers of firestop system products certifying that products furnished comply with requirements.

D. Product Test Reports: From a qualified testing agency indicating firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance. Acceptable installer firms shall be:

1. FM Approved in accordance with FM Standard 4991 – Approval of Firestop Contractors.
2. Firestop Contractors International Association Contractor Member in good standing.
3. Licensed by the State or local authority, where applicable.
4. Shown to have successfully completed not less than 5 comparable scale projects.

B. Single Source Responsibility: Obtain firestop systems for each kind of penetration and construction condition indicated from a single primary firestop systems manufacturer.

1. Materials of different manufacture than allowed by the tested and listed system shall not be intermixed in the same firestop system or opening.
2. Tested and listed firestop systems are to be used before an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) is installed.

C. Fire-Test-Response Characteristics: Provide firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:

   a. Firestop system products bear classification marking of qualified testing and inspecting agency.
   b. Firestop systems correspond to those indicated by reference to firestop system designations listed by the following:

      1) UL in "Fire Resistance Directory."

D. Engineering Judgments: Where there is no specific third party tested and classified firestop system available for a particular application, obtain from the firestop manufacturer an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) to be submitted to the Architect and authority having jurisdiction for approval prior to installation.
E. Preinstallation Conference: Before installing firestop systems, conduct conference at Project site to comply with requirements of Division 01 Section "Project Meetings." Notify participants at least 5 working days before conference.

1. Meet with Owner; Architect; inspection agency representative; firestop Installer(s); manufacturer's technical representative; and installers whose work interfaces with or affects firestopping, including Division 22 through 26 subcontractors.

2. Coordination of Trades: Coordinate firestop systems for all penetrations and construction conditions to provide consistency in quality, manufacturer and installation of materials. Coordinate with work of Divisions 22 through 26.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver 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 firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install 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 firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate firestop systems.

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. 3M Fire Protection Products.
4. Tremco.
5. W.R. Grace.
6. Other manufacturers listed in the UL Fire Resistance Directory.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating firestop systems, under conditions of service and application, as demonstrated by firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by 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.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide firestop systems containing the types of fill materials standard with manufacturer for systems complying with rating requirements indicated. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
H. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. Silicone Sealants: Moisture-curing, 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 and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

   2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.


2.4 MIXING

A. For those products requiring mixing before application, comply with 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 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 firestop systems.

   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with 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 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 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 FIRESTOP SYSTEM INSTALLATION

A. General: Install 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 12-inch wide fire safining strip at ceiling/floor juncture.

C. 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.

D. 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

   1. Inspecting agency will state in each report whether inspected firestop systems comply with or deviate from requirements and if installation process conforms to FM 4991 – Standard for Approval of Firestop Contractors.

B. Proceed with enclosing firestop systems with other construction only after inspection reports are issued.

C. Where deficiencies are found, repair or replace firestop systems so they comply with requirements.
3.5 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 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 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 firestop systems immediately and install new materials to produce on firestop systems complying with specified requirements.

END OF SECTION 078413
SECTION 078446 - FIRE-RESISTIVE JOINT 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 fire-resistive joint systems for the following:
   1. Joints in or between fire-resistance-rated constructions.
B. Related Sections include the following:
   1. Division 07 Section "Penetration Firestopping" for systems installed in openings in walls with and without penetrating items.
   2. Division 07 Section "Joint Sealants" for non-fire-resistive joint sealants.

1.3 PERFORMANCE REQUIREMENTS
A. 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 assembly in which fire-resistive joint systems are installed.
B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities and L-ratings indicated as determined by UL 2079.
   1. Load-bearing capabilities as determined by evaluation during the time of test.
C. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.
   1. 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.
C. Product Certificates: For each type of fire-resistant joint system, signed by product manufacturer.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

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

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installation Responsibility: Assign installation of fire-resistant joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain fire-resistant joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide fire-resistant joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

   1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistant joint systems acceptable to authorities having jurisdiction.

   2. Fire-resistant joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:

      a. Fire-resistant joint system products bear classification marking of qualified testing and inspecting agency.

      b. Fire-resistant joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistant 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.

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

1.7 PROJECT CONDITIONS

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

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

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

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

C. 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.

D. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector of 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. 3M Fire Protection Products.
4. Tremco.
5. W.R. Grace.
6. Other manufacturers listed in the UL Fire Resistance Directory.

2.2  FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, 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.

B. 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 and floor or floor/ceiling assemblies.
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.

C. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.
PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

A. 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.

B. 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.

C. 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 or damaging adjoining surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. 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.

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

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
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 fire-resistive joint systems and prepare inspection reports.

B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.

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

C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.

D. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

A. 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.

B. 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. This Section includes joint sealants for the applications indicated in the Joint-Sealant Schedule at the end of Part 3.

1.3 PERFORMANCE REQUIREMENTS
A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS
A. Product Data: For each joint-sealant product indicated.

B. 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.

C. Samples for Verification: For each type 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.

D. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

E. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE
A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
C. 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 type 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 of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.6 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. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric 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 elastomeric sealant manufacturer agrees to furnish elastomeric 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 Silicone Sealants: 20 years from date of Substantial Completion.
2. Warranty Period for Urethane Sealants: 5 years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
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 sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 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.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric 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.

2.3 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 790.
   b. GE Advanced Materials - Silicons; SilePruf LM SCS2700.
   c. Pecora Corporation; 890.
   d. Sika Corporation, Construction Products Division; SikaSil-C990.
   e. Tremco Incorporated; Spectrem 1.
B. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products:
   a. BASF Building Systems; Omniplus.
   b. Dow Corning Corporation; 786 Mildew Resistant.
   c. GE Advanced Materials - Silicones; Sanitary SCS1700.
   d. Tremco Incorporated; Tremsil 200 Sanitary.

2.4 URETHANE JOINT SEALANTS

A. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

1. Products:
   a. BASF Building Systems; Sonolastic SL 1.
   c. Pecora Corporation; Urexpan NR-201.
   d. Sika Corporation. Construction Products Division; Sikaflex - 1CSL.
   e. Tremco Incorporated; Vulkem 45.

B. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products:
   b. BASF Building Systems; Sonolastic NP1.
   c. Tremco; Vulkem 116.

2.5 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

B. Products:
   1. Pecora Corporation; AC-20+.
   2. Sonneborn, Division of ChemRex Inc.; Sonolac.
   3. Tremco; Tremflex 834.

2.6 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type 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) or other type, 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 where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 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, blast cleaning, 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.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on 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 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 type 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 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.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 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.

3.5 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.
3.6 JOINT-SEALANT SCHEDULE

A. Interior joints in horizontal traffic surfaces:
   1. Joint Locations:
      a. Control and expansion joints in tile flooring.
      b. Other joints as indicated.
   2. Joint Sealant: Pourable urethane sealant.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

B. Interior joints in vertical surfaces and horizontal nontraffic surfaces:
   1. Joint Locations:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Tile control and expansion joints.
      d. Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
      e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
      f. Other joints as indicated.
   2. Joint Sealant: Single-component neutral-curing silicone sealant or single component nonsag urethane sealant, as recommended by manufacturer.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

C. Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces:
   1. Joint Sealant Location: Joints between plumbing fixtures and adjoining walls, floors, and counters.
   2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces:
   1. Joint Location: Acoustical joints where indicated.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

E. Perimeter joints between interior wall surfaces and casework, and frames of interior doors and windows.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

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. This Section includes the following:
      1. Steel door frames.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.
   B. Shop Drawings: Include the following:
      1. Elevations of each door design.
      2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
      3. Locations of reinforcement and preparations for hardware.
      4. Details of each different wall opening condition.
      5. Details of anchorages, joints, field splices, and connections.

1.4 QUALITY ASSURANCE
   A. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.
   B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are 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 252.
      1. Test Pressure: After 5 minutes into the test, the neutral pressure level in the furnace shall be established at 40 inches or less above the sill.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Deliver frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished frames.
   B. Inspect frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinshed items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.
C. Store frames at building site under cover. Place units on minimum 4-inch-high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked units to permit air circulation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

2.2 FRAMES

A. General: Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet, shop primed.

2. Frames for Wood Doors: 0.053-inch-thick steel sheet, unless otherwise indicated.

C. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.

D. Supports and Anchors: Fabricated from not less than 0.042-inch-thick, electrolytic zinc-coated or metallic-coated steel sheet.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.3 FABRICATION

A. General: Fabricate steel frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.


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

D. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
E. Hardware Preparation: Prepare frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for frame preparation for hardware.

F. Frame Construction: Fabricate frames to shape shown.
   1. For interior applications, fabricate knocked-down frames.
   2. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame.

G. Reinforce frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

H. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

2.4 FINISHES

A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install steel frames and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
   1. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
   2. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.
   3. Install fire-rated frames according to NFPA 80.
   4. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.

3.2 ADJUSTING AND CLEANING

A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from frames.

END OF SECTION 081113
SECTION 081416 - FLUSH WOOD DOORS

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

1.3 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; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.

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 cardboard cartons and wrap bundles of doors in plastic sheeting.
C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer’s standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
2. Warranty shall be in effect during the following period of time 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. Flush Wood Doors:
   a. Eggers Industries; Architectural Door Division.
   b. Marshfield Door Systems, Inc.
   c. Oshkosh Architectural Door Co.

2.2 DOOR CONSTRUCTION, GENERAL

A. Doors for Transparent Finish:

1. Grade: Custom (Grade A faces).
2. Species and Cut: Walnut, plain sliced.
4. Assembly of Veneer Leaves on Door Faces: Balance match.

2.3 SOLID-CORE DOORS

A. Interior Veneer-Faced Doors:

1. Core: Structural composite lumber or particleboard.
2. Construction: Five plies.
2.4 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors:
   1. Wood Species: Same species as door faces.
   2. Profile: Flush rectangular beads

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:

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, DHI A115-W series standards, and hardware templates.
   1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Transom Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
   1. Light Openings: Trim openings with moldings of material and profile indicated.

2.6 FACTORY FINISHING

A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.

B. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.

C. Transparent Finish:
   1. Grade: Premium
   2. Stain: As selected by Architect.
   3. Finish: AWI System TR-6 catalyzed polyurethane or TR-4 conversion varnish.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Manufacturer's Written Instructions: Install doors to comply with manufacturer’s written instructions, referenced quality standard, and as indicated.

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 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 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. Interior aluminum-framed storefronts.

B. Related Requirements:

1. Section 088000 "Glazing" for glass for interior storefront.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

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

B. Structural Loads: As indicated on Drawings.

C. Deflection of Framing Members: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330.

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

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.

1.6 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.

1.7 WARRANTY

A. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 20 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. EFCO Corporation.
2. Kawneer.
3. YKK AP America Inc. - YES 40 FS Storefront (Basis of Design)

2.2 MATERIALS

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

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
4. Structural Profiles: ASTM B 308/B 308M.

B. Steel Reinforcement: With manufacturer's standard 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 A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

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. Construction: Framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance.

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. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
   2. Reinforce members as required to receive fastener threads.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

2.5 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."

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.

2.6 FABRICATION
A. Form aluminum shapes before finishing.

B. 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 cope 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. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

D. Storefront Framing: Fabricate components for assembly using shear-block system or screw-spline system.

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Finish: One of the following as selected by Architect:
   1. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
   2. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker; color as selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. 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.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or 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. Install components plumb and true in alignment with established lines and grades, without warp or rack.

D. Install glazing as specified in Division 08 Section "Glazing."

E. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" and to produce weathertight installation.

F. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum 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.
3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

END OF SECTION 084113
SECTION 087100 – FINISH HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Definition: "Finish Hardware" includes items known commercially as finish / security hardware and systems which are required for swing, sliding and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.

B. Extent of finish / electrified hardware required is indicated on drawings and in schedules.

C. Types of finish hardware required include, but are not limited to, the following:

- Butt Hinges/Continuous Hinges
- Lock cylinders and keys
- Lock and latch sets
- Closers
- Protection plates
- Smoke Gaskets

D. References

- NFPA – 70 – National Electric Code s adopted
- ADA – The Americans with Disabilities Act – Title III – Public Accommodations
- ANSI-A156.5-American National Standards Institute – Auxiliary Locks and Associated Products
- International Building Code as Adopted
- Positive Pressure Testing UL10C & UBC7.2
- UL - Underwriters Laboratories
- WHI – Warnock Hersey International, Division of Inchscape Testing Services
- State, Local and Federal Codes, National Electrical Building Codes, including the Authority Having Jurisdiction

1.3 RELATED WORK

A. Steel Doors and Frames - Section 081113.

B. Flush Wood Doors - Section 081416.
1.4 QUALITY ASSURANCE

A. Manufacturer: Obtain each type of hardware (ie lock sets) from a single manufacturer, although several may be indicated as offering products complying with requirements.

B. Supplier: A recognized architectural finish hardware supplier, with warehousing facilities, who has been furnishing hardware and installation in the project's vicinity for a period of not less than 4 years. The supplier shall be, or shall employ, a certified Architectural Hardware Consultant (AHC) who is available, at reasonable times during the course of the work, for consultation about project's hardware requirements, to the Owner, Architect and the Contractor. The certified architectural hardware consultant (AHC) shall prepare all hardware and wiring diagrams. This Supplier is responsible for proper coordination of all finished hardware with related sections to insure compatibility of products.

C. Fire-Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80 and local building code requirements. Provide only hardware, which has been tested and listed by UL / WHI or FM for types and sizes of doors required and complies with requirements of door and door frame labels. Provide door seals to meet Positive Pressure Testing UL10C and UBC7 – 2 as required.

D. Where emergency exit devices are required on fire-rated doors (with supplementary marking on doors' UL or FM labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL / WHI or FM label on exit devices indicating "Fire Exit Hardware".

E. Thru-bolt door closers and exit devices as standard application. Verify and coordinate with the MUSC Project Manger. If solid blocking is specified in the wood door specification, thru-bolts may not be required for hardware attachment in these doors.

F. Unless otherwise specified, provide lever handle locksets ADA compliant.

G. Pre-Installation Meeting: The Contractor shall initiate and conduct a jobsite meeting with the hardware supplier and the Installer, and all related trades for mechanical and electrical hardware. This meeting shall convene at least one month prior to commencement of the related work, specifically, the electrical rough-in for coordination of electrified hardware applications. All approved shop drawings, wiring diagrams, and schedules shall be made available to all related trades as required for work to be performed. The Owner’s representative shall attend all pre-install meetings. In addition to reviewing and the coordinating the applications, the hardware supplier shall, with the assistance of the manufacturer’s representative, provide a review and training to the Installers of the following products prior to installation of these products: closers, exit devices, locks, and electrified hardware. The Hardware Supplier shall provide a written certificate of attendance to the Installers at the training. The Hardware Supplier shall provide the Contractor the names of the training attendees.

H. Keying Meeting: A keying conference shall be conducted following the approval of all hardware submittals on each MUSC construction project where new locks and/or cylinders are being furnished. Attendance to this meeting shall be: Project Architect, MUSC Project Manager, MUSC Locksmith, the Hardware Supplier, and any Owner requested user.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data for each item of hardware in accordance with Division-1 section "Submittals". Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish.
B. Hardware Schedule: Submit five copies of schedule in accordance with Division 1 – “Submittals”, General Requirements. Schedule to be in vertical format, listing each door opening, including: Keying Information, handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door openings as intended, and finish of hardware. At doors with door closers or door controls, include degree of door opening. All submittals (schedules, cut sheets, diagrams) shall be reviewed by the MUSC project manager prior to ordering of material. Supply the schedules and all templates within two (2) weeks from date purchase order is received by the door openings supplier. Furnish wiring diagrams (elevation, riser) for all electrified hardware.

1. Final Hardware Schedule Content: Based on finish hardware indicated, organize hardware schedule into a vertical format with “hardware sets” indicating complete designations of every item required for each door or opening. Include the following information:
   a. Type, style, function, size and finish of each hardware item.
   b. Name and manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of hardware set cross-referenced to indications on
   e. Drawings both on floor plans and in door and frame schedule.
   f. Explanation of all abbreviations, symbols, codes, etc., contained in schedule.
   g. Mounting locations for hardware.
   h. Door and frame sizes and materials.
   i. Keying information.
   j. Describe door operation function with the electrified hardware.

C. Submittal Sequence: Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames), which is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by finish hardware, and other information essential to the coordinated review of hardware schedule.

D. Keying Schedule: Owner will self-perform keying.

E. Samples if Requested: Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit any requested samples of type of exposed hardware unit, finished as required, and tagged with full description for coordination with schedule.

F. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location, coordination and installation of hardware.

G. Manufacturer’s Catalog Cuts: Submit manufacturer’s cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.

1.6 PRODUCT HANDLING

A. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Inventory hardware jointly with the General Contractor, representatives of hardware supplier / hardware installer until each is satisfied that count is correct.

C. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.
D. The General Contractor shall provide secure lock-up for hardware and security equipment delivered to the project, but not yet installed. Control handling and installation of hardware items, which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

1.7 SEQUENCING AND SCHEDULING

A. Deliver all finish hardware to the job site in a timely manner so not to delay progress of other trades.

1.8 WARRANTY

A. Provide manufacturers’ warranties as follows:
   2. Mortise Locksets: 3-year warranty, minimum, against manufacturing defects and workmanship.
   3. Door Closers: 30-year warranty, minimum, against manufacturing defects and workmanship.
   4. Exit Devices: 3-year warranty, minimum, against manufacturing defects and workmanship.
   5. Balance of items shall carry a manufacturer’s 1-year warranty against manufacturing defects and workmanship.

B. During the warranty period, replace defective product, including labor, materials, and other costs incidental to the work. Upon written notice from the MUSC Project Manager, the Contractor and the Hardware Supplier shall inspect the work within 24 hours after completion, and provide written receipt of completion of the warranty work to the MUSC Project Manager.

PART 2 - PRODUCTS

2.1 SCHEDULED HARDWARE

A. Requirements for design, grade, function, finish, size and other distinctive qualities of each type of finish hardware is indicated in the Hardware Sets at the end of this section. Products are identified by using hardware designation numbers of the following:

<table>
<thead>
<tr>
<th>Hardware Item</th>
<th>Specified Manufacturer</th>
<th>Designation</th>
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<tbody>
<tr>
<td>Butts:</td>
<td>Ives</td>
<td>IVE</td>
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<tr>
<td>Locksets:</td>
<td>Corbin-Russwin</td>
<td>C-R</td>
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<tr>
<td>Cylinders/Cores:</td>
<td>Corbin-Russwin</td>
<td>C-R</td>
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<tr>
<td>Silencers:</td>
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<td>Gasket/Door Bottoms:</td>
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<td>Kickplates:</td>
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B. Provide products as hereafter specified. Substitutions other than those manufacturers listed, must be approved, in writing, via addenda, prior to bid. Procedure for substitutions shall be as outlined in Division 1. No substitutions will considered after award of contract.

2.2 MATERIALS AND FABRICATION

A. General:
1. Hand of door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
2. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels and as otherwise acceptable to Architect.
3. Manufacturer's identification will be permitted on rim of lock cylinders only.
4. Finishes:
   a. 626/652 for all finished metal hardware items except as 630 is otherwise indicated. Door closers to be powder coated to match 652/626. Exit devices to be US26D with stainless steel touchbars.
5. Lockset Design: Lever handle design shall be “LWA” for mortise locks.
6. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware, which has been prepared for self-tapping sheet metal screws, except, as specifically indicated.
7. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
8. Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Use thru-bolts for closer and exit devices. Coordinate wood door blocking at all wood doors and all fire rated wood doors. Provide sleeves for each thru-bolt or use sex screw fasteners.
9. Tools and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.3 HINGES AND BUTTS

A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

B. Screws: Furnish Phillips flat-head or machine screws for installation of units, except furnish Phillips flat-head or wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.

C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

1. Steel Hinges: Steel pins.
5. Interior Doors: Non-rising pins.
6. Tips: Flat button
7. Number of hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90” or less in height and one additional hinge for each 30” of additional height.
2.4 LOCK CYLINDERS AND KEYING

A. Equip locks and cylinders with cylinders for interchangeable core, 7-pin housings with construction cores as specified. All cylinders and cores shall be by Corbin-Russwin. The hardware supplier shall furnish “0” bitted permanent Corbin-Russwin cores, and two (2) each key blanks per lock. The blanks shall be stamped: “Do Not Duplicate”. All permanent cores/cylinders and keys shall be shipped directly to the Owner from the factory. The Owner shall perform the keying and install all permanent keyed cores. Furnish permanent cores in the keyway specified in the Hardware Sets, Part 3.

D. Furnish temporary Construction Keyed cores for the duration of the construction period. Construction cores shall be furnished as L4 keyway x Red Core, and not part of the Owner’s existing key system. The Hardware Supplier shall furnish the construction cores and they shall remain the property of the Hardware Supplier. The Contractor shall return all construction cores and keys to the Hardware Supplier at project completion. Furnish five (5) Construction Keys and one (1) control key for the General Contractor’s use during project construction.

E. Equip locks with cylinders that comply with performance requirements for Grade 1 cylinders as listed in ANSI A156, and are UL-listed.

F. Permanent keys: Allow 2 each key blanks keys per lock. Key blanks shall be furnished as: 39A1-6-pin.

G. Bitting List: Not required. Owner shall perform all permanent keying.

H. Key Quantity/ Extras: 5 each extra “UC” cores x 2 each key blanks

2.5 LOCKS, LATCHES AND BOLTS

A. Locksets shall be as specified: Mortise type lockset shall be Series 1000, Grade 1 Operational and Security, UL Listed for 3-hour fire door. Approved manufacturers: Corbin-Russwin ML2000 series. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with ANSI curved lip extended to protect frame, finished to match hardware set. Where specified, provide a vandal resistant trim. At single toilet rooms specify privacy as ML2060 function. Electrified mortise locks shall be “EU”, electric unlock. The Hardware Supplier shall verify the lock and the lock trim included on existing doors adjacent to/included in the new project work, and advise the GC and Architect if different from the trim style specified in the attached Hardware Sets.

B. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.

C. Lock Throw: Provide solid stainless steel 1 ½” deadbolt with 1” minimum throw. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

D. Provide 3/4” minimum throw on latch bolts.

E. Flush Bolt Heads: Minimum of 1/2” diameter rods of brass, bronze or stainless steel, with minimum 12” long rod for doors up to 7'-0” in height. Provide longer rods as necessary for doors exceeding 7'-0” in height.

2.6 PULLS/ PUSH PLATES

A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation; through-bolted for matched pairs, but not for single units. Furnish type and size as specified in Hardware Sets.
2.7 CLOSERS AND DOOR CONTROL DEVICES

A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer’s recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.

B. Closers: All door closers shall be of one manufacturer to provide for proper installation and servicing after installation. All closers shall be inspected after installation by a factory representative to ensure proper adjustment and operation. A report shall be filed with the architect after said visit has been made. Closer shall carry a manufacturer’s 30-YEAR WARRANTY for hydraulic units and 2 year warranty for electrical and/or handicap power assist door closers against manufacturing defects and workmanship. All closers shall be high strength cast iron with one piece forged steel piston. PRV [pressure relief valves] are not acceptable.

C. Parallel Arm Closers: Shall incorporate one piece solid forged steel arms with bronze bushings. 1-9/16” x 1/2” steel stud shoulder bolts, shall be incorporated in regular arms, hold open arms, arms with stop built in, arms with hold open and stop built in. All other closers shall have forged steel main arms for strength, and durability.

D. Built-In Stops: Where closers with built-in positive stops are used, the stops shall be of one piece cast malleable iron material with built in springs. Where required, the hold-open assembly handle for these stops shall rotate on ball bearings.

E. All door closers shall pass UL10C positive pressure fire test.

F. Non-sized and specific to door mounting: All exterior closers shall be non-sized to provide a full range of Size 1 to 5 closing power, and shall be handed.

G. Hydraulic Fluid: All closers, with the exception of interior electronic closers, shall utilize temperature stable fluid capable of withstanding temperature ranges of 120 degrees F. to -30F. without requiring seasonal adjustment of closer speed to properly close the door. Fluid shall be nonflammable.

H. All closers shall have a powder coat finish on closer body, arm, cover and adapter plate. Furnish special rust inhibiting pre-treat coating, as specified, for closer body, arm, cover and plates before the powder coat finish.

I. Provide all drop plates, shoe supports, templates, etc. to properly mount closers according to manufacturers’ recommendations.


K. Closers shall be thru-bolt mounted, unless otherwise directed.

2.8 EXIT DEVICES

A. General: All devices shall be of one manufacturer to provide for proper installation and servicing. Devices shall be furnished non-handed and capable of direct field conversion for all available trim functions. All devices shall carry a three year warranty against manufacturing defects and workmanship. All devices shall be either narrow-stile cross-bar type or push-through touch pad design as specified. No exposed touch bar fasteners, no exposed cavities when operated.
B. Furnish all touch-pad type devices with stainless steel touch bars. Plastic parts are not acceptable.

C. Furnish all touch-pad type exit devices with deadlocking latch bolts. Latchbolts shall be moly-coated to reduce friction against the strike.

D. Furnish all touch-pad exit devices with heavy duty cast metal end caps, flush with device housing.

E. Furnish roller strikes with all rim exit devices.

F. Furnish stabilizers similar to Von Duprin 154 with all removable mullions.

G. Outside Trim: Shall be heavy duty type and fastened by means of concealed welded lugs and thru-bolts from the inside. Trim shall be forged brass with a minimum average thickness on the escutcheon of .130. Plate with trim shall be brass with minimum average thickness of .090 and have forged pulls. Where Lever Handles are specified provide 996 type Break Away Trim. Where outside trim is specified, furnish trim that thru-bolts directly to the exit device center case.

H. Furnish cylinders with all lockable exit devices. Except on fire-rated doors, wherever closers are provided on doors equipped with exit devices, equip the units with keyed dogging device to hold the push bar down and the latch bolt in the open position.

I. Furnish required filler plates and shim kits for flush mounting of exit devices on all doors requiring same.

J. Springs: Compression type only. Torsion springs are not acceptable.

K. The preferred exit device: Von Duprin 35A/98 series. Electrified devices shall include the QEL feature at all rim-mounted applications.

I. Exit devices shall be furnished with thru-bolts.

J. Acceptable exit device applications: Rim and Surface Vertical Rod. Removable Mullions are not acceptable, unless it is the only approved application for a fire-rated pair of doors.

2.9 DOOR TRIM UNITS

A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops and similar units); either machine screws or self-tapping screws.

B. Fabricate edge trim of stainless steel, not more than 1/2" nor less than 1/16" smaller in length than door dimension.

C. Fabricate protection plates (armor, kick or mop) not more than 2" less than door width on stop side and not more than 1" less than door width on pull side, x the height indicated.

C. Metal Plates: Stainless steel, .050" (U.S. 18 ga.), bevel 3 edges: top and both sides.

2.10 GASKETS, DOOR BOTTOMS

A. General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf, except where stated the door manufacturer will provide the weatherstripping. Provide type, sizes and profiles shown or scheduled. Provide non-corrosive fasteners as recommended by manufacturer for
application indicated. All gaskets for fire label doors shall comply the door manufacturers label approvals. Fire-label wood doors shall be furnished as “Category A” type with the intumescent seal, integrated into the door construction.

2.11 THRESHOLDS

A. General: Except as otherwise indicated provide standard aluminum threshold unit of type, size and profile as shown or scheduled.

B. Provide thresholds that are 1” wider than depth of frame.

C. Provide thresholds with return closed ends where specified in Hardware Sets.

2.12 DOOR SILENCERS

A. All hollow metal frames shall have gray resilient type silencers. Quantity (3) on single doors and quantity (2) on pair of doors.

2.13 MISCELLANEOUS

A. Coat Hook: Provide one (1) each coat hook at each office door. Coat hook shall be as Ives #572.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces, which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division-9 sections. Do not install surface-mounted items until finishes have been completed on the substrate.

C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

C. Drill and countersink units, which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

D. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.

E. Adjust and reinforce attachment substrate for proper installation and operation:
   Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc.

F. Locate floor stops not more than 4 inches from the wall.

G. Install closers and exit devices with the manufacturer’s provided thru-bolts. Verify this mounting with the architect and the Owner.
H. Certified Installers: Prior to installation of Locksets, Closers, and Exit Devices, hardware installers shall be trained by the manufacturers’ representative of each product. This training shall be conducted during the Pre-Installation Meeting at the project site.

3.2 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units, which cannot be adjusted to operate freely and smoothly as intended for the application made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Instruct Owner’s Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

D. Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Installer, accompanied by the representative[s] of the Finish Hardware manufacturer[s], shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner’s personnel in recommended additions to the maintenance procedures. Replace hardware items, which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of all current or predictable problems (of substantial nature) in the performance of the hardware and furnish copy to Owners Agent / Representative.

3.3 HARDWARE SETS AS FOLLOWS:

HARDWARE SET NO. 01 -

FOR USE ON MARK/DOOR # (S):
BS433A  BS433B  BS433C  BS433D

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END SECTION 087100
SECTION 088000 - GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Doors.
   2. Sidelites.
   3. Interior borrowed lites.
   4. Interior storefront framing.

1.3 SUBMITTALS
A. Product Data: For each glass product and glazing material indicated.
B. Product Certificates: For glass and glazing products, from manufacturer.

1.4 QUALITY ASSURANCE
A. 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.
B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

1.5 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.
B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.
1.6  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.

1.7  WARRANTY

A.  Manufacturer's Special Warranty for 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: 10 years from date of Substantial Completion.

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.  Minimum Glass Thickness for Lites: Not less than 6.0 mm.

B.  Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. 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.  Thermal and 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.

2.2  MONOLITHIC GLASS PRODUCTS

A.  Float Glass: ASTM C 1036; Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B.  Heat-Treated Float Glass: ASTM C 1048; 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 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

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, seals of insulating-glass units, 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. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Single-Component, Nonsag, Neutral-Curing Silicone Glazing Sealant: 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. BASF Building Systems; Omniseal 50.
   b. Dow Corning Corporation; 995.
   c. GE Advanced Materials - Silicones; UltraPruf II SCS2900.
   d. Pecora Corporation; 898.
   e. Sika Corporation, Construction Products Division; SikaSil-C995.
   f. Tremco Incorporated; Spectrem 3.

2.5 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. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.6 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.

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. 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.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 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 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.

D. Install gaskets so they protrude past face of glazing stops.

3.5 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.

3.6 MONOLITHIC-GLASS SCHEDULE

A. Clear Glass (CG): Clear float glass, fully tempered where indicated.

1. Thickness: 6.0 mm.
3.7 LAMINATED GLASS SCHEDULE

A. Laminated Glass (LG): Clear laminated glass with two plies of fully tempered float glass.

1. Minimum Thickness of Each Glass Ply: 6 mm.
2. Interlayer Thickness: 0.060 inch.
3. Safety glazing required.

END OF SECTION 088000
SECTION 092216 - NON-STRUCTURAL METAL FRAMING

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 non-load-bearing steel framing members for the following applications:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: For interior partitions and soffits, showing details of seismic bracing and fastener requirements.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: One of the following:
   b. Meeting requirements of ASTM C645-07; C-channel, roll-formed from galvanized steel; complying with ASTM A1003 and ASTM A653 G40 or equivalent corrosion resistant coating.

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

1. Steel Framing and Furring:
a. Steel Stud Manufacturers’ Association or Steel Framing Industry Association (SFIA) members.
b. ClarkDietrich Building Systems ProSTUD Drywall Framing System.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.

1. Depth: 2 inches, unless otherwise indicated.

D. Furring Channels (Furring Members):

   a. Minimum Base Metal Thickness: 0.0179 inch.

E. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Chicago Metallic Corporation; Drywall Furring System.
   c. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.02 inch (20 gauge equivalent), or greater as required to comply with manufacturer’s requirements for limiting heights and applied loads
2. Minimum Base-Metal Thickness for Door Jamb Studs: 0.02 inch (20 gauge equivalent).
3. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Steel Network Inc. (The); VertiClip SLD Series.
      2) ClarkDietrich Building Systems; BlazeFrame.
C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the 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. Products: Subject to compliance with requirements, provide one of the following:
   a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
   b. Metal-Lite, Inc.; The System.
   c. ClarkDietrich Building Systems; BlazeFrame.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0312 inch.

E. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch wide flanges.

1. Depth: 1-1/2 inches, unless indicated otherwise.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch (25 gauge equivalent).
2. Depth: 7/8 inch.

G. Resilient Furring Channels: 1/2-inch deep, steel sheet members designed to reduce sound transmission.


2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

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.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

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.
   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

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. Do not attach hangers to steel roof deck.
   5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
F. 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.

G. 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.

3.5 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.
   1. Space studs as follows: 16 inches o.c., unless otherwise indicated.

C. Install tracks (runners) 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 penetrating 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 runner 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.

D. Direct Furring:
   1. 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.

END OF SECTION 092216
SECTION 092900 - GYPSUM BOARD

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. Interior gypsum board.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Samples: For the following products:
   1. Trim Accessories: Full-size Sample in 12-inch long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE
A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 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 E 90 and classified according to ASTM E 413 by an independent testing agency.

1.5 STORAGE AND HANDLING
A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS
A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
B. Do not install interior products 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 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Gypsum.
   b. G-P Gypsum.
   c. National Gypsum Company.
   d. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch, or as otherwise indicated.
2. Long Edges: Tapered.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

2. Shapes:
   a. LC-Bead: J-shaped; exposed long flange receives joint compound.
   b. Expansion (control) joint.

B. Gypsum Board Corners:

1. Materials: Corner shapes of tapered copolymer core with specially formulated surface paper.
2. Basis-of-Design Product: No-Coat Structural Laminate Drywall Corner System or approved equal.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.
B. Joint Tape:
   1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints 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 drying-type, all-purpose compound.
      a. Use setting-type compound for installing paper-faced metal trim accessories.
   3. Fill Coat: For second coat, use drying-type, all-purpose compound.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to existing painted substrate at windows.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

D. Sound Attenuation Blankets: ASTM C 665, 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.

E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, 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 C 840.
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. STC-Rated Assemblies: 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 for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Type X: Vertical surfaces, unless otherwise 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.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer’s written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

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 C 840, at maximum 30 o.c. spacing and in specific locations approved by Architect for visual effect.

C. Interior Trim: Use LC-Bead at exposed panels edges.

D. Corners: Mud in No-Coat corner pieces. Promptly remove residual joint compound from adjacent surfaces.

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 those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

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.

3.6 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. 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
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 acoustical panels and exposed suspension systems for ceilings.
B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
   2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- long Samples of each type, finish, and color.
C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
D. Maintenance Data: For finishes to include in maintenance manuals.

1.4 QUALITY ASSURANCE
A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
   1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages 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.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, 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.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide
products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 MINERAL-BASE ACOUSTICAL PANELS:

A. Manufacturers:
   1. USG Corporation; “Frost ClimaPlus” Item No. 418 (Basis of Design).

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
   1. Type and Form: Type III, mineral base with painted finish; Form 4.
   2. Pattern: E.

C. Color: White.

D. NRC: Not less than 0.70.

E. Light Reflectance: 0.84.

F. Edge Detail: Reveal sized to fit flange of exposed suspension-system members.

G. Thickness: 3/4 inch.

H. Size: 24 by 24 inches.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
   1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
   3. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
G. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

2.4 METAL SUSPENSION SYSTEM:

A. Manufacturers:

1. USG Corporation; “Centricitee 9/16” Exposed Tee System” (Basis of Design).

B. Narrow-Face, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/653M, not less than G30 coating designation, with prefinished 9/16-inch wide metal flanges.

   1. Structural Classification: Heavy-duty system.
   2. Flanges: Flat, flush.
   3. Face Finish: Painted white.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers:

1. Armstrong World Industries, Inc.
2. Chicago Metallic Corporation.
3. USG Interiors, Inc.

B. Roll-Formed Sheet-Metal Edge Moldings and Trim: Provide perimeter trim, designed to fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

C. Beam End Retaining Clips: As approved by authority having jurisdiction, provide beam end retaining clips for perimeter attachment of suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

   1. ACM7 by USG.

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. 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, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, GENERAL

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."


1. Space vertical hanger wires on main tees not more than 48 inches o.c., or as required to support loads. Attach hanger wires directly to the structure above, not greater than 1 in 6 out of plumb. Space vertical hanger wires on main tees not more than 48 inches o.c., or as required to support loads. Attach hanger wires directly to the structure above, not greater than 1 in 6 out of plumb.
   a. Trapeze and Splay wires may be installed as detailed in ASTM C 636.
   b. Do not support wires from mechanical and/or electrical equipment, piping or other equipment occurring above ceiling.
   c. Connection device from vertical wire to the structure above must sustain minimum 100 lbs.

2. Perimeter hanger wires on each perimeter tee end not more than 8 inches from the wall.

3. Perimeter tee ends must be tied together to prevent spreading; this may be accomplished with approved grid end clips per approved manufacture’s ICC-ESR.

4. Perimeter closure molding, minimum 7/8 inch with approved grid end clips per approved manufacture’s ICC-ESR.

5. Grid connection to perimeter, fixed on two adjacent walls.

6. Grid connection to perimeter, floating on two adjacent walls and cut back 3/4”.

7. Lighting Fixtures:
   a. All light fixtures shall be mechanically attached to the suspension system per NEC 410-16 (two per fixture unless the fixture is independently supported).
   b. Support of rigid lay-in (Type G) or can light fixtures.
      1) Each fixture less than 10 lbs. shall have a single wire (wire may be slack) attached from the fixture to structure.
      2) Each fixture that weighs between 10 and 56 lbs. shall have two wires (wires may be slack) attached at diagonal corners of the fixture to structure.
      3) Each fixture greater than 56 lbs. shall be directly supported to structure by approved hangers.
      4) Pendant light fixtures shall be directly supported from structure with 9-gauge wire (or approved alternative).

8. Air Terminals:
   a. Air terminals less than 20 lbs. shall be positively attached to the suspension syst.
      1) Air terminals that weigh between 20 and 56 lbs. shall be mechanically attached to the suspension system. Two slack wires shall be attached from the housing to structure.
      2) Air terminals in excess of 56 lbs. shall be directly supported to structure by approved hangers.

9. Splay Wire and Compression Posts:
a. Horizontal restraint (splay wires or rigid bracing) within 2 inches of intersection and
splayed 90° apart at 45° angles. Splay bracing connection strength 200 lbs or the design
load, whichever is greater.
b. Compression posts (struts) 12 feet o.c. in both directions, starting 6 feet from the wall.

10. Seismic Separation Joint: Required for areas >2,500 sq. ft.
11. Rigid bracing required for ceiling plane elevation changes.
12. Sprinkler heads and other penetrations must have 2 inch clearance or a swing joint.
13. Cable trays and electrical conduit must be independently supported and braced.
14. Partitions must be braced to structure independent of the ceiling.

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. Screw attach moldings to substrate at intervals 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, 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 a neat, precise fit.

1. 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.

3.4 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. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113
SECTION 096519 - RESILIENT TILE FLOORING

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. Vinyl composition tile (VCT).
2. Resilient base.
3. Resilient molding accessories.

1.3 SUBMITTALS

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

B. Samples for Verification: Full-size units of each color of resilient tile, base and accessory required.

C. Maintenance Data: For resilient products to include in maintenance manuals.

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. Store tiles on flat surfaces.

1.5 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After postinstallation period, maintain 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 floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install resilient products after other finishing operations, including painting, have been completed.
PART 2 - PRODUCTS

2.1 VINYL COMPOSITION TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Essentials by Mannington Mills, Inc. or Architect approved comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. Tarkett, Inc.

B. Vinyl Composition Tile (VCT): ASTM F 1066.

C. Class: 2 (through-pattern tile).

D. Wearing Surface: Smooth.

E. Thickness: 0.125 inch.

F. Size: 12 by 12 inches.

2.2 RESILIENT WALL BASE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Traditional Wall Base by Johnsonite or Architect approved comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. Roppe Corporation.

B. Wall Base: ASTM F 1861.

C. Type (Material Requirement): Type TV (vinyl, thermoplastic).

D. Profile:

2. Style B, Cove: Provide in areas with resilient flooring.

E. Minimum Thickness: As indicated on Drawings.

F. Height: 6 inches in Classroom; match height of Corridor base in Vestibules.

G. Colors and Patterns: As selected by Architect from manufacturer’s full range.

2.3 RESILIENT MOLDING ACCESSORY

A. Description: Carpet edge for glue-down applications; nosing for carpet; and as otherwise indicated.

1. Armstrong World Industries, Inc.
2. Johnsonite.
3. Roppe Corporation.
B. Material: Rubber.

C. Profile and Dimensions: As indicated.

D. Colors: As selected by Architect from full range of industry colors.

2.4 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 manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

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.

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

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

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 manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
   a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Where sufficient leveling of floor cannot be achieved through repair underlayment, fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so 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 tiles square with room axis, unless otherwise indicated.

B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

G. Adhere tiles to flooring 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 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Job-Formed Corners:
1. **Outside Corners:** Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.

2. **Inside Corners:** Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3. **Do not place joint between lengths of base material within 12 inches of corners.**

### 3.5 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 coverings that would otherwise be exposed.

### 3.6 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.
   a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.
   a. Use commercially available product acceptable to manufacturer.
   b. Coordinate selection of floor polish with Owner's maintenance service.

2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.

3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 096519
SECTION 096813 – TILE CARPETING

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 modular, carpet tile.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

   B. Shop Drawings: Show the following:
      1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
      2. Carpet tile type, color, and dye lot.
      3. Type of subfloor.
      4. Type of installation.
      5. Pattern of installation.
      6. Pattern type, location, and direction.
      7. Pile direction.
      8. Type, color, and location of insets and borders.
      9. Type, color, and location of edge, transition, and other accessory strips.
     10. Transition details to other flooring materials.

   C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
      2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch-long Samples.

   D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

   E. Qualification Data: For Installer.

   F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

   G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to carpet tile installation including, but not limited to, the following:

1. Review delivery, storage, and handling procedures.
2. Review ambient conditions and ventilation procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where exhibits or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, and delamination.


1.8 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd

PART 2 - PRODUCTS

2.1 CARPET TILE (CPT-1, CPT-2 and CPT-3)

A. Basis-of-Design Products: As indicated on Finish Schedule.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.

2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813
SECTION 098433 - SOUND-ABSORBING WALL UNITS

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 shop-fabricated, fabric-wrapped panel units tested for acoustical performance, including:
   1. Sound-absorbing wall panels.

1.3 DEFINITIONS
A. NRC: Noise reduction coefficient.

1.4 SUBMITTALS
A. Product Data: For each type of panel edge, core material, and mounting indicated.
B. Shop Drawings: For acoustical wall panels. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, wall intersections and any penetrations through panels. Include elevations showing panel sizes and direction of fabric weave and pattern matching. Indicate panel edge and core materials. Provide elevation drawings showing panel joint locations.
C. Samples for Verification: For the following products. Prepare Samples from same material to be used for the Work.
   1. Fabric: Full-width by 36-inch- long Sample from dye lot to be used for the Work.
   2. Panel Edge: 12-inch- long Sample showing edge profile, corner, and finish.
   3. Core Material: 12-inch- square Sample showing corner.
   5. Sample Panels: No larger than 36 by 36 inches. Show joints and mounting methods.
D. Product Certificates: For each type of acoustical wall panel, signed by product manufacturer.
E. Maintenance Data: For acoustical wall panels to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.
F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE
A. Source Limitations: Obtain acoustical wall panels through one source from a single manufacturer.
B. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and acoustical wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

C. Protect panel edges from crushing and impact.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical wall panels until spaces are enclosed and weatherproof, 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. Lighting: Do not install acoustical wall panels until a permanent level of lighting is provided on surfaces to receive acoustical wall panels.

C. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify locations of acoustical wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

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

1. Failure in performance includes, but is not limited to, acoustical performance.
2. Failures in materials include, but are not limited to, fabric sagging, distorting, or releasing from panel edge; or warping of core.
3. Warranty Period: Two years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 ACOUSTICAL WALL PANELS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Acousti-Tack Fiberglass Wall Panels by G&S Acoustics or comparable product by one of the following:

1. AVL Systems, Inc.
2. Conwed Designscape.
3. Decoustics, Ltd.
4. Wall Technology.

B. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core.

1. Panel Shape: Flat.
2. Mounting: Back mounted with manufacturer's standard clips, secured to substrate.
3. Core: Glass-fiber or mineral-fiber board.
   a. Core-Face Layer: Manufacturer's standard tackable, impact-resistant, high-density board.
4. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
5. Edge Profile: Eased (small radius).
6. Corner Detail in Elevation: Square with continuous edge profile indicated.
7. Facing Material: Guilford FR701 fabric; color and pattern as selected by Architect from manufacturer's full range.
8. Acoustical Performance: Sound absorption NRC of 0.90 according to ASTM C 423 for Type A mounting according to ASTM E 795.
10. Panel Width: As indicated on Drawings.
11. Panel Height: As indicated on Drawings.

2.2 FABRICATION

A. Sound-Absorption Performance: Provide acoustical wall panels with minimum NRCs indicated, as determined by testing per ASTM C 423 for mounting type specified.

B. Acoustical Wall Panels: Panel construction consisting of facing material adhered to face, edges and back border of dimensionally stable core; with rigid edges to reinforce panel perimeter against warpage and damage.

C. Fabric Facing: Stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other foreign matter. Applied with visible surfaces fully covered.

1. Where square corners are indicated, tailor corners.

D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
E. Back-Mounting Devices: Concealed on backside of panel, recommended to support weight of panel, and as follows:

1. Metal "Z" Clips: Two-part panel clips, with one part of each clip mechanically attached to back of panel and the other part to wall substrate, designed to allow for panel removal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, substrates, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of acoustical wall panels.

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

3.2 INSTALLATION

A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with acoustical wall panel manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.

C. Match and level fabric pattern and grain among adjacent panels.

D. Installation Tolerances: As follows:

1. Variation from Level and Plumb: Plus or minus 1/16 inch.
2. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

3.3 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that acoustical wall panels are without damage or deterioration at time of Substantial Completion.

B. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 098433
SECTION 099123 - INTERIOR PAINTING

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 surface preparation and field painting of exposed and interior items and surfaces.
      1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
   B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
      1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
   C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
      1. Submit Samples on rigid backing, 8 inches square.
      2. Step coats on Samples 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 List: For each product indicated, include the following:
      1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
      2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
1.4 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish samples of each type of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared samples.

1. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
   a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.
   b. Doors: Provide full size samples for interior doors.
   c. Small Areas and Items: The Architect will designate an item or area as required.

2. After permanent lighting and other environmental services have been activated, apply coatings to each surface according to the Schedule or as designated by Architect. Provide required sheen, color, and texture on each surface.
   a. After finishes are accepted, the Architect will use the benchmark sample to evaluate coating systems of a similar nature.

3. Final approval of colors will be from job-applied samples.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Color name and number.
   8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.
1.6 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Benjamin Moore & Co.
2. PPG Architectural Finishes, Inc.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:

1. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
2. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

C. Colors: As selected by Architect from manufacturer’s full range.

2.3 BLOCK FILLERS

2.4 PRIMERS/SEALERS
   A. Interior Latex Primer/Sealer: MPI #50.

2.5 METAL PRIMERS
   A. Rust-Inhibitive Primer (Water Based): MPI #107.
   B. Waterborne Galvanized-Metal Primer: MPI #134.

2.6 LATEX PAINTS
   A. Institutional Low-odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).
   B. Institutional Low-odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).

2.7 STAINS
   A. Stain, Semi-Transparent, for Interior Wood: MPI #90.

PART 3 - EXECUTION

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

3.2 PREPARATION
   A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
   B. Remove plates, machined surfaces, and similar items already in place that 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.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

F. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

G. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

H. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.

3.3 APPLICATION

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.

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. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces.
3.4 FIRE RATED ASSEMBLIES

A. Permanently identify corridor partitions, smokestop partitions, horizontal exit partitions, exit enclosures and fire walls. Above decorative ceiling line and in concealed spaces, apply a minimum one-inch wide red line interrupted at maximum 15-ft spacing with the wording "X HOUR FIRE AND SMOKE BARRIER - PROTECT ALL OPENINGS" in 4-inch high letters with "X" designating the appropriate hourly rating.

3.5 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner reserves the right to engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.6 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

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. CMU Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 4.2E.

B. Steel Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
a. Prime Coat: Rust-inhibitive primer (water based).

C. Galvanized-Metal Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 5.3N.

D. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.

E. Plaster Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.

F. Wood:

1. Semitransparent Stain System:
   b. Topcoat: Stain, semi-transparent, for interior wood, MPI #90.

END OF SECTION 099123
SECTION 101100 - VISUAL DISPLAY SURFACES

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. Markerboards.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Samples for Verification: For each type of visual display surface indicated and as follows:
      1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
   C. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE
   A. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Store visual display units vertically with packing materials between each unit.

1.6 PROJECT CONDITIONS
   A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
      1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating visual display surfaces without field measurements. Coordinate wall construction to ensure that actual dimensions correspond to established dimensions.
      2. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.
1.7 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Surfaces lose original writing and erasing qualities.
   b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: 50 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. Best-Rite Manufacturing.
2. Claridge Products & Equipment, Inc. (Basis of Design)
3. Egan Visual Inc.
4. Gent Manufacturing Inc.
5. Marsh Industries, Inc.

2.2 MATERIALS, GENERAL

A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
   1. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.

B. Particleboard: ANSI A208.1, Grade 1-M-1.

C. Extruded Aluminum: ASTM B 221, Alloy 6063.

2.3 MARKERBOARD ASSEMBLIES

A. Porcelain-Enamel Markerboard Assembly: Balanced, high-pressure, factory-laminated markerboard assembly of 3-ply construction consisting of backing sheet, core material, and 0.021-inch-thick, porcelain-enamel face sheet with gloss finish.
   1. Particleboard Core: 3/8 inch thick; with 0.015-inch-thick, aluminum sheet backing.
   2. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.
   3. Locations: As indicated on Drawings.

2.4 MARKERBOARD ACCESSORIES
A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; of size and shape indicated.


B. Chalktray: Manufacturer's standard, continuous.

   1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

2.5 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to neat, hairline closure.

   1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

C. 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.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.

   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine walls and partitions for proper backing for visual display surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between visual display boards and surfaces.

1. Prime wall surfaces indicated to receive visual display boards, as recommended in writing by manufacturer.

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation. Provide metal blocking at each location.

1. Provide shims to provide ventilation space between back of visual display surface and wall.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

1. Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than 24 inches o.c.

a. Attach chalktrays to boards with fasteners at not more than 12 inches o.c.

3.5 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer’s written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100
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. Wall guards.
   2. Corner guards.

1.3 SUBMITTALS
A. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.

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. Include Samples of accent strips to verify color selected.
   1. Wall Guards: 12 inches long. Include examples of joinery, corners, end caps, and field splices.
   2. Corner Guards: 12 inches long.

D. Maintenance Data: For each impact-resistant wall-protection unit to include in maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE
A. Fire-Test-Response 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 testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Store impact-resistant wall-protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

   1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic sheet material out of direct sunlight.
3. Store plastic wall-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

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.

B. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall-protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Extruded Rigid Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; thickness as indicated.
   1. Impact Resistance: Minimum 25.4 ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.
   2. Chemical and Stain Resistance: Tested according to ASTM D 543.
   3. Self-extinguishing when tested according to ASTM D 635.
   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 B 221 for Alloy 6063-T5.

C. 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.

2.2 WALL GUARDS

A. Crash Rail: Heavy-duty assembly consisting of continuous snap-on plastic cover installed over concealed retainer system; designed to withstand impacts.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Acrovyn Model FR-225N by Construction Specialties, Inc.
   2. Cover: Extruded rigid plastic, minimum 0.100-inch wall thickness; as follows:
      a. Profile: Convex.
      b. Color and Texture: As selected by Architect from manufacturer’s full range.
   3. Continuous Retainer: Minimum 0.080-inch thick, one-piece, extruded aluminum.
   4. Retainer Clips: Manufacturer’s standard impact-absorbing clips designed for heavy-duty performance.
5. Bumper: Continuous rubber or vinyl bumper cushion(s).
6. End Caps and Corners: Prefabricated, injection-molded plastic; matching color cover; field adjustable for close alignment with snap-on cover.
7. Accessories: Concealed splices and mounting hardware.
8. Mounting: Surface mounted directly to wall.

2.3 CORNER GUARDS

A. Surface-Mounted, Resilient, Plastic Corner Guards: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface, installed over continuous retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition; full wall height.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Acrovyn Model SM-20N by Construction Specialties, Inc.
2. Cover: Extruded rigid plastic, minimum 0.078-inch wall thickness; as follows:
   a. Profile: Nominal 3-inch- long leg and 1/4-inch corner radius.
   b. Height: As indicated.
   c. Color and Texture: As selected by Architect from manufacturer's full range.
3. Retainer: Minimum 0.060-inch- thick, one-piece, extruded aluminum.
4. Retainer Clips: Manufacturer's standard impact-absorbing clips.

2.4 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.

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.
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 mounting hardware, anchors, and other accessories required for a complete installation.
   a. Provide anchoring devices to withstand imposed loads.
   b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.
   c. 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.

END OF SECTION 102600
SECTION 230500 – MECHANICAL AND ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, General Requirements and all other Specification Sections apply to the work specified in this section.

1.2 SCOPE

A. This Section describes the general provisions for the fire protection, plumbing, mechanical and electrical work included in Divisions 22 and 23 respectively. Refer to Division 26 for additional General Provisions related to electrical work.

1.3 RESPONSIBILITY

A. The General Contractor shall be responsible for all work included in the Mechanical and Electrical Divisions. The delegation of work to Subcontractors shall not relieve him of this responsibility. Subcontractors who perform work under these Sections shall be responsible to the General Contractor. The term "Contractor" is used throughout this Division and shall mean the General Contractor, although the actual performance of the work may be by a Subcontractor.

B. The Contractor shall carefully review all divisions of the project specifications. Where conflicts exist between divisions and/or sections of the specifications the most stringent requirement as determined by the Architect shall apply.

C. The contractor shall obtain and pay for all installation permits, certificates, and inspection fees relative to the work. The preparation of any specific plans or shop drawings necessary to obtain these permits shall also be the responsibility of the contractor.

1.4 REFERENCES AND DEFINITIONS

Following are definitions of terms and expressions used in the Mechanical and Electrical Sections:

- Provide - furnish and install
- Directed - directed by the Architect
- Indicated - indicated in Contract Documents
- Concealed - hidden from normal sight; includes items within furred spaces, pipe and duct shafts, above suspended ceilings and within return air plenums.
- Exposed - non concealed - Work within Equipment Rooms shall be considered exposed.
- Exterior - items being or situated outside. Items located within a crawl space shall be considered exterior.
- Conditioned - a heated or cooled space, or both, within a building and, where required, provided with humidification or dehumidification means, so as to be capable of maintaining a space condition falling within the comfort envelope set forth in ASHRAE 55.
- Piping - includes pipes, fittings, valves, hangers, and accessories comprising a system.
Ductwork - includes ducts, fittings, housings, dampers, hangers, air devices, and accessories comprising a system.

1.5 STANDARD SPECIFICATIONS

A. See Division 1 - General Requirements.

B. References to catalogs, standards, codes, specifications, and regulations apply to the latest edition in effect at the date of the invitation to bid.

1.6 CODES, REGULATIONS, AND PERMITS:

A. All materials furnished and all work installed shall comply with the applicable International Code Council codes.

1.7 EQUIPMENT START-UP AND INITIAL OPERATION

A. No equipment shall be operated, for testing or trial use, before full compliance with the equipment manufacturers’ specifications and instructions for the lubrication, alignment, direction of rotation, balance, and other applicable considerations.

B. Particular care shall be taken to see that all equipment is completely assembled, properly lubricated, and all grease and oil cases and reservoirs have been filled to the correct level with the recommended lubricants.

C. It is the Contractor’s responsibility to place each item of equipment, installed by him, in operating condition. This responsibility includes all auxiliaries, piping, wiring, etc., the start up of each unit, and a check of its performance.

1.8 WARRANTY

A. The Contractor warranty, by his acceptance of the Contract, that all work installed, by him or his subcontractors, will be free from defects, in workmanship and materials, for a period of one (1) year after the date of certification of completion and acceptance of work. Any defects in workmanship, materials or performance which appear within the guarantee period shall be corrected by the Contractor, without cost to the Owner, within a reasonable time to be specified in notice from the Architect. In default thereof, Owner may have such work done and charge the cost of same to the Contractor.

1.9 DRAWINGS

A. The Contract Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Any offsets, rises, or transitions not shown on the drawings and required to provide a complete system shall be provided at no additional contract cost. Do not scale the drawings. Consult the Architectural and Structural drawings and details for exact location of structure and equipment; where same are not definitely located, obtain this information from the Architect.
1.10 ELECTRICAL WORK

A. Under Division 23 MECHANICAL, provide the following items of electrical work which shall conform with the applicable requirements of the Electrical Division:

1. Low voltage temperature control wiring.
   a. Concealed wiring shall be installed in conduit.
   b. Exposed wiring shall be installed in conduit.
   c. Refer to Section 260533 - Raceways and Boxes for Electrical Systems for installation requirements.

2. Interlock wiring for mechanical equipment and devices.

B. Under Division 16 ELECTRICAL, provide:

1. Power wiring, complete from power source to motor or equipment junction box, including power wiring through motor starters, power factor correction devices, and line reactors. Power factor correction devices shall be provided under Division 23 and installed under Division 16.

1.11 SINGULAR NUMBER

A. Where any device or part of equipment is herein referred to in the singular number (such as "valve"), such reference applies to as many such devices as are required to complete the installation as shown on the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials shall be new, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building, and shall be of reputable manufacturers'. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the sections following.

B. See Division 1 - General Requirements. All component parts of each items of equipment or device shall bear the manufacturers' name plate; giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc., in order to facilitate the maintenance or replacement. The name plate of a subcontractor or distributor will not be acceptable. Where Underwriters' Laboratories standards apply, material and equipment shall be approved by them and shall bear the UL Label.

C. In specifying materials, three (3) general procedures are used. The three (3) classifications are as follows:

   GROUP 1: When a material or equipment is specified by brand name or other identifying information and three (3) or more brands are named it is considered that any one (1) of the brands so named will perform as desired, and the Contractor shall base his proposal on one (1) of the named brands. The first brand named or identified basis of design shall be used as a standard. The other brands named shall be equal to the specified brand in all respects. If one (1) of the other brands named is used it shall be the Contractor's responsibility to verify proper clearances and fit of the substituted equipment.
GROUP 2: When the material or equipment is specified with the phrase "...or approved equal..." after a brand name and other identifying information, it is intended that the brand name is used for the purpose of establishing a minimum acceptable standard of quality and performance and Contractor may base his bid proposal on any item which is in all respects equal to that specified and presents essentially the same appearance. It shall be the Contractor’s responsibility to ensure proper fit and clearances of all substituted equipment.

GROUP 3: When material is specified as complying with the requirements of published "Standard Specification" of trade associations, American Society of Testing and Materials, government specifications, etc. the Contractor shall base his proposal on any item which can be shown to comply in all respects to the referred "Standard Specification".

1. It is distinctly understood: (1) that the Architect will use his own judgment in determining whether or not any materials, equipment or methods offered in substitution are equal to those specified; (2) that the decision of the Architect on all such questions of equality is final; and (3) that all substitutions will be made at no increase in cost to the Owner.

2. Upon receipt of written approval from Architect, Contractor may proceed with substitution providing Contractor assumes full responsibility for, and makes, at his own expense, any changes or adjustments in construction or connection with other work that may be required by the substitution of such materials, equipment or methods. In the event of any adverse decisions by the Architect no claim of any sort shall be made or allowed against the Owner.

2.2 PIPING, CONDUITS, AND SUPPORTS, GENERALLY

A. All piping, ductwork, and equipment shall be suspended from the structure above unless otherwise indicated or noted on the drawings. The Contractor shall obtain prior approval from the Architect for floor supports of piping, ductwork, and equipment. Provide structural steel members consisting of angles, channels, and beams as required to hang piping, ductwork, and equipment.

B. Piping and conduits, except electrical conduits run in floor construction, shall be run parallel with the lines of the building, unless otherwise shown or noted on the drawings.

C. Electrical conduits shall not be hung on hangers with any other service pipes.

D. The different service pipes, valves, and fittings shall be so installed that after the covering is applied there will not be less than ½-inch clear space between the finished covering and other work and between the finished covering and parallel adjacent pipes.

E. Hangers on different service lines, running parallel with each other and nearly together, shall be in line with each other and parallel to the lines of the building.

F. Exact location of sprinklers, electrical outlets, piping, ducts, and conduits shall be coordinated among the trades so that there will be no interference between lighting fixtures, piping, ducts, and conduits. Where conflicts between the trades result, they shall be resolved by the Contractor to the Architect’s satisfaction and at no expense to the Owner.

G. Hangers shall be spaced to prevent sag and permit proper drainage. Refer to Division 23, Section “Basic Materials and Methods” for hanger type and spacing.

2.3 SLEEVES AND PLATES

A. All pipe sleeves shall be constructed of one (1) piece Schedule 40 steel pipe, unless otherwise indicated
B. Escutcheon plates shall be provided for all exposed pipes passing through walls and ceilings in finished areas.
   1. Plates shall be chrome plated brass, split ring type, and sized to match the pipe or insulation where installed.

C. Escutcheon plates shall be provided for all exposed ducts passing through walls in finished areas.
   1. Plates for ducts shall consist of painted sheet metal flanges (color to match the wall) of same material thickness as the duct. Overlap openings on all sides by at least 1.5 inches..

D. At all fire rated separations, seal all openings between pipes and ducts and corresponding sleeve to maintain fire rating of the wall or ceiling. Submit method of sealing sleeves for approval. U.L. assembly rating of fire walls shall be maintained at all times. All sleeves installed in masonry or concrete construction shall be grouted in place.

2.4 FIRE RATED PENETRATION SYSTEMS

A. Provide UL Listed fire penetration systems in openings in rated floors, walls, and other elements of construction. Provide UL listed fire penetration systems at all new and existing pipe penetrations of new and existing rated construction within the area of work. Coordinate work of this section with all other trades necessary for the proper installation of the fire rated penetration systems.

B. Submit shop drawings showing each condition requiring penetration seals in dictating proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction. Submit a copy of UL illustration of each proposed system indicating manufacturer approved modifications. Submit copies of manufacturer's specifications, recommendations, inspection requirements, installation instructions, and maintenance data for each type of material required. Include letter indicating that each material complies with the requirements and is recommended for the applications shown.

C. All fire penetration systems shall reference ASTM E814/UL 1479 - Fire Test of Through - Penetration Fire Stops.

D. All systems shall be UL tested and listed in the UL Fire Resistance Directory.

E. Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one (1) year from date of substantial completion.

F. 3M products have been specified as the penetration fire stop basis of design. Other manufacturer's systems are acceptable providing they meet the requirements set forth in this specification. The fire rated penetration systems shall be the products of one manufacturer to the maximum extent possible. The products of more than one manufacturer shall not be used as a combined seal.

G. Provide materials classified by UL to provide fire stopping equal to time rating, both “F” and “T” ratings, of construction being penetrated. Provide asbestos free materials that comply with applicable codes and have been tested under positive pressure in accordance with UL 1479 or ASTM E814. Systems shall be smoke and air tight.
H. Deliver material undamaged in manufacturer's clearly labeled, unopened containers identified with brand, type, grade, and UL label where applicable. Coordinate delivery with scheduled installation date to allow minimum storage time at site. Store material in clean, dry ventilated location. Protect from soiling, abuse, and moisture. Follow manufacturer's instruction.

I. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

J. Furnish adequate ventilation if using solvent. Furnish forced air ventilation during installation if required by manufacturer. Keep flammable materials away from sparks or flame. Provide masking and drop cloths to prevent contamination of adjacent surfaces by fire stopping resistance.

K. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose, materials, rust, or other substances that may affect proper fitting, adhesion of the required fire resistance.

L. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instructions. Seal holes or voids made by penetrations to ensure an effective smoke barrier. Where floor openings without penetrating items are more than four (4) inches in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor. Protect materials from damages on surfaces subject to traffic.

M. Clean up spills of liquid components. Neatly cut and trim materials as required. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

N. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspection by applicable code authorities. Perform under this section patching and repairing of fire stopping caused by cutting or penetration by local inspectors and other trades.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. Each Subcontractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work.

B. The quality of workmanship required, for each trade, in the execution of work shall be the finest and highest obtainable in that trade working with the materials specified. Workmanship shall be satisfactory to the Architect and his decision as to acceptable quality is final.

C. Workmanship proven to be of poor quality or unsatisfactory in the commissioning phase of the project as deemed by the Architect shall be removed and replaced to the satisfaction of the Architect.

3.2 EQUIPMENT PERFORMANCE

A. All equipment, devices, controls, and hardware shall be proven to operate successfully throughout the guarantee period. Systems shall be proven during all weather seasons and be demonstrated to affect the design conditions at times. System components or equipments items that fail to consistently deliver the design conditions shall be removed and replaced as directed by the Architect. The cost of required equipment replacements shall be borne by the Contractor.
B. All equipment shall be tested after installation and be proven to deliver the manufacturers quoted design capacity. When capacity is in question as deemed by the Architect, the Contractor shall perform a detailed and comprehensive field performance test to certify the equipment capacity. System effect or installed performance factors may not be applied to performance ratings unless they were previously included when the equipment was submitted for approval. Equipment that fails to deliver manufacturers quoted design capacity shall be removed and replaced at the Contractors expense.

C. Workmanship proven to be of poor quality or unsatisfactory in the commissioning phase of the project as deemed by the Architect shall be removed and replaced to the satisfaction of the Architect.

3.3 EQUIPMENT CONNECTIONS

A. All equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer's instructions and recommendations. Auxiliary piping, piping specialties, water seals, valves, and electric connections recommended by the manufacturer, required by code or required for proper operation shall be provided.

3.4 CUTTING AND PATCHING

A. Cutting and patching associated with the work in the existing structure shall be performed in a neat and workmanlike manner. Existing surfaces, which are damaged by the Contractor, shall be repaired or provided with new materials. All patching shall be done with materials and methods similar to existing adjacent work, subject to approval of the Architect. Structural members shall not be cut or penetrated. Holes cut through concrete and/or masonry to accommodate new work shall be cut by reciprocating or rotary, non-percussive methods.

B. The Contractor shall submit to the Architect for approval dimensioned drawings showing all penetrations through structural slabs or walls required for mechanical and electrical work. Drawings shall clearly show opening size, plan location, and/or elevation as applicable. All openings shall be approved by the Architect prior to starting work.

C. Patching of areas disturbed by installation of new work shall match existing adjacent surfaces in material, texture, and color.

3.5 INTERRUPTION OF EXISTING UTILITIES

A. Notify the Owner in writing at least seven (7) days in advance of any required shutdown of water, sewage, gas, electrical service or other utility. Upon written receipt of approval from Owner, shutdowns shall be performed between the hours of six (6) p.m. and six (6) a.m. including clean-up or as directed otherwise and shall be accomplished at no additional cost.

3.6 PROTECTION EXISTING WORK

A. When working in and around the building, extreme care shall be exercised with regard to protection of the structure and mechanical and electrical services. Repair or replace, to the satisfaction of the Architect, any work damaged in the performance of the new work.
3.7 SURVEYS AND MEASUREMENTS

A. Base all measurements (both horizontal and vertical) from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check correctness of same as related to the work. Verify locations of existing utilities and inverts of same prior to the start of any systems shown connecting to existing utilities.

B. Should the Contractor discover any discrepancy between actual measurements or conditions, and those indicated, which prevent following good practice or the intent of the drawings and specifications, he shall notify the Architect and shall not proceed with his work until he has received instruction from the Architect.

3.8 HANDLING AND STORAGE OF MATERIAL

A. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of all materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials are damaged.

B. All mechanical and/or electrical equipment delivered to the job site shall be stored on pedestals, above the ground and under roof or other approved covering. All enclosures for equipment shall be weatherproof. All motors, drives, switchgear, panels, etc. which are not totally enclosed, that are involved in the work, shall be stored in a heated, dry, water protected area with a minimum temperature of fifty degrees (50) Fahrenheit. All valves shall be stored under roof on wood pedestals, above ground. All insulation shall be stored under roof or in trailers, adequately protected from the weather. The Contractor shall follow all written instructions and recommendations of the manufacturer and all requirements of the Architect in oiling, protection and maintenance of equipment during storage. It shall be the Contractor's complete responsibility for the storage and care of the equipment and materials.

C. If any equipment and/or materials are found to be in poor condition at the time of installation the Architect may, at his discretion, order the Contractor to furnish and install new equipment and/or material at no cost to the Owner.

3.9 COOPERATION WITH OTHER TRADES

A. Mechanical and Electrical trades shall give full cooperation to other trades and shall furnish in writing, with copies to Architect any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay. Exact location of all mechanical and electrical equipment, devices, etc. in finished spaces shall be coordinated with Architectural reflected ceiling plans, elevations and details.

3.10 CLEANING AND PAINTING

A. Thoroughly clean all exposed surfaces of equipment and material and leave in a neat, clean condition ready for painting. Restore and touch-up factory finishes which have been damaged during construction. Finished painting will be performed under another Division.

B. Miscellaneous requirements include:

1. Touch-up threads of zinc coated screwed pipe with Rust-O-Leum primer and one (1) coat of enamel conforming with painting specification.
2. Paint behind grilles and registers in finished areas with two (2) coats of flat black paint following
the proper surface preparation of the zinc coated metal.

3.11 ACCESSIBILITY

A. Locate all equipment which must be serviced, operated, or maintained, in fully accessible positions to eliminate the need for access panels and doors. Equipment shall include, but not be limited to, valves, clean-outs, motors, controllers, dampers, drain points, etc.

B. Where overhead equipment cannot be located above spaces with either no ceilings or removable acoustical ceiling tiles, contractor shall provide, as part of the contract and no expense to the Owner, fourteen (14) gauge painted steel access doors where required and/or where directed (color shall match ceiling).

1. Access doors shall be Milcor or approved equal to suit material in which installed.
2. Access doors installed in fire rated walls or shafts shall be labeled and shall match rating of the construction.
3. Doors shall be of sufficient size to allow access to all components; minimum size shall be eighteen (18) inches by eighteen (18) inches.
4. All doors shall have cylinder locks operable from same key.

C. Equipment deemed inaccessible by the Architect shall be reworked by the Contractor at no expense to the Owner. All doors shall have cylinder locks operable from same key. Submit shop drawings for approval.

3.12 EQUIPMENT SUPPORTS

A. Refer to Division 23, “Mechanical Vibration, Sound and Seismic Controls” for vibration isolation and seismic restraint requirements.

B. Supports will be furnished and installed under this Division and shall be in accordance with Division 3.

C. Under this Section, provide all equipment supports; consisting of platforms, gratings, structural members and related materials required for the mechanical and electrical work.

D. The type and size of the supporting channels and supplementary steel shall be determined by the Subcontractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

3.13 DEMOLITION

A. All existing piping, conduit, equipment, ductwork, and materials not required for re-use or re-installation shall be removed. Any existing materials and equipment which are removed and are desired by the Owner, or are indicated to remain the property of the Owner, shall be delivered to him on the premises by the Contractor where directed by the Architect. All other materials and equipment which are removed shall become the property of the Contractor and shall be removed by him from the premises.

B. Existing piping that remains concealed, buried, or otherwise contained in the remaining slabs and walls shall be capped, plugged, or otherwise sealed. All pipes shall be cut so that their capped or plugged ends will be below the finished floors or behind finished surfaces.

C. Existing wiring, where possible, shall be removed or pulled through conduits. Wiring remaining shall be cut back behind the termination of conduits so that conduits can be adequately capped, plugged, or sealed.
3.14 CONNECTIONS AND ALTERATIONS TO EXISTING WORK

A. When existing mechanical and electrical work is removed, all pipes, valves, ducts, and materials shall be removed to a point below the finished floors or behind finished walls and capped. Such points shall be far enough behind finished surfaces to allow for the installation of the normal thickness of finished material.

B. When the work specified hereinafter connects to existing equipment, piping, or ductwork, the Contractor shall perform all necessary alterations, cuttings, or fitting of existing work as may be necessary or required to make satisfactory connections between the new and existing work and to leave the completed work in a finished and workmanlike condition, to the entire satisfaction of the Architect.

C. When the work specified hereinafter or under other divisions of the contract necessitates relocation of existing equipment, piping, or ductwork, the Contractor shall perform all work and make all necessary changes to existing work as may be required to leave the completed work in a finished and workmanlike condition, to the satisfaction of the Architect. All work resulting in an extra to the contract shall be approved by the Owner and Architect before proceeding.

D. All cutting and patching necessary for the installation of the mechanical work shall be done under this Division. Any damage done to the work already in place shall be repaired at the Contractor's expense. Patching shall be uniform in appearance and shall match the surrounding surface.

3.15 INTERRUPTION OF EXISTING UTILITIES

A. Interruptions during periods of normal building occupancy shall be kept to a minimum. Interruptions shall only occur after a schedule of proposed outage times is submitted to and approved by the Architect.

B. At the end of each interruption, all services shall be restored so that normal use of the building can continue.

END OF SECTION 230500
SECTION 230530 – BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, General Requirements and all other Specification Sections apply to the work specified in this section.

1.2 SCOPE

A. This section includes requirements for items of mechanical equipment, materials and procedures which are common to more than one section of Division 23 and which are general in nature and use. This section applies to all sections of Division 23.

B. The requirements of Division 23, Section “Mechanical and Electrical General Provisions” shall apply to all work specified under this section.

1.3 SHOP DRAWINGS

A. Submit shop drawings for all items of materials specified in this section in accordance with the General Requirements.

1.4 TESTS AND ADJUSTMENTS

A. The Contractor shall furnish labor, instruments, equipment, and materials required to perform tests prescribed in the sections describing the various systems. All tests shall be performed in the presence of the Owner and/or the Architect. A minimum forty-eight (48) hours prior notice shall be given to the Owner and Architect for all tests. A written test report shall be submitted following all tests and before systems are insulated.

B. Replace or repair defects found during inspection or tests with new materials. Caulking of welded joints, screwed joints, cracks, or holes is not acceptable. Correct leaks in screwed fittings by remaking joints. Cut out and reweld. Repeat tests after defects have been eliminated.

C. Where reasonable doubt exists as to a system's ability to comply with contract requirements, perform any reasonable test required by the Architect.

D. Make static pressure tests and prove to the satisfaction of the Architect the piping is tight before pipes are concealed. Tests shall be provided as hereinafter specified.

E. Use test instruments tested for accuracy by an approved laboratory or by the instrument manufacturer, and furnish certificates showing degree of accuracy to the Architect when requested. Make calibration histories for each instrument available for examination.

F. Where gauges, thermometers and other instruments which are to be left permanently installed are used for tests, do not install until just prior to the tests to avoid possible changes in calibration.
1.5 REFERENCES AND DEFINITIONS

A. Unless otherwise specifically indicated, the term, and requirements of, “domestic” water systems shall apply universally apply to all potable, HVAC make-up and industrial laboratory water systems.

PART 2 - PRODUCTS

2.1 HANGERS:

A. See Division 23, Section “Mechanical and Electrical General Provisions” for general requirements.

B. It shall be the responsibility of the Contractor to provide an adequate pipe hanger and support system for all pipe systems in accordance with recognized engineering practices, using standard, commercially accepted pipe hangers and suspension equipment.

1. For all pipe hangers, supports, anchors, guides, etc., submit a pipe hanger assembly drawing in accordance with the recommendations provided by ANSI/MSS SP-58-2009.
2. Provide proposed equipment manufacturer, manufacturer’s model number and size, construction, finish, quantities and/or lengths.
3. Utilize columns shown on Contract Drawings for the location plan.
4. Indicate pipe system, line size, insulation thickness, and Contract Drawing for which the plan view of the pipe hanger location can be found.

C. Hangers and accessories shall be Anvil International, B-Line, Basic Engineering, Carpenter-Patterson, Kindorf, Michigan, Mueller or Unistrut. Unless otherwise specified, or indicated on the drawings, pipe and conduit hangers and hanger supports shall conform to the following Anvil International figures.

1. Hangers generally shall be Figs. 65, 104, 212, 260 and 295.
2. Hanger Figs. 212 and 295 shall be provided with turnbuckles and eye rods or rods with eye nuts.
3. Turnbuckles shall be Figs. 114 or 230, shall have not less than 1-1/2 inches of adjustment, and shall be provided with locknuts.
4. Brackets Figs. 194, 195, and 199 shall be used for support of pipe hangers on lines larger than four (4) inches run along walls near floors.
5. Riser clamps shall be Figs. 261 (steel and cast iron piping) or CT-121 (copper piping).
6. Roller supports shall be adjustable, Anvil International Fig. 274 for installation of hot service piping over two (2) inches in size and installed in racks or on trapeze hangers.
7. Concrete inserts shall be Figs. 281 or 282.
8. On copper pipes, hangers in contact with pipe shall be copper plated.

D. The design of all hangers and supports shall conform to the latest requirements of ANSI/ASME B31.9 and Manufacturers’ Standardization Society (MSS) Standard Practice SP-58, unless otherwise made more stringent below.

1. Hangers for steel pipe, except as noted otherwise, shall be spaced at least every ten (10) feet.
2. Hang and support cast iron soil pipe and fittings in accordance with the recommendations of the Cast Iron Soil Pipe’s Institute’s (CISPI) Cast Iron Soil Pipe and Fittings Handbook. At a minimum, hangers shall be provided at each joint.
3. Hangers for copper pipe shall be placed at least every eight (8) feet, except pipes ¾-inch and smaller shall have hangers at six (6) foot intervals.
4. Plastic and polypropylene piping systems 1 ¼” and smaller shall be provided with continuous pipe support using light gauge sheetmetal angles strapped to pipes.
5. Hangers shall be placed within one (1) foot of each horizontal and vertical elbow.
6. Vertical runs of pipe less than fifteen (15) feet long shall be supported by hangers placed one (1) foot or less from the elbows on the connecting horizontal runs.

7. Vertical runs of pipe over fifteen (15) feet long, but not over sixty (60) feet long, and not over six (6) inches in size, shall be supported by heavy steel clamps.

8. Clamps shall be bolted tightly around the pipes and shall rest securely on the building structure without blocking.

9. Clamps may be welded to the pipes or placed below coupling.

10. Where concentrated loads of valves, fittings and similar items occur, closer hanger spacing will be necessary.

E. All brackets used for supporting piping shall be provided by the Contractor and shall be of welded steel construction with a design safety factor of not less than five.

F. Hangers for piping 2-1/2 inches and smaller shall be the standard clevis type.

1. Hangers for un-insulated copper piping shall be copper plated.
2. Hangers for insulated plumbing piping and sanitary, storm water and vent piping shall be steel.

G. In lieu of individual hangers, multiple (trapeze) hangers may be used for water pipes having same elevation and slope and for electrical conduits as specified hereinafter:

1. Horizontal members shall consist of 1-1/2 inch by 1-1/2 inch twelve (12) gauge, cold formed, lipped channels designed to accept special, springheld, hardened steel nuts for securing hanger rods and other attachments. Two (2) or more such channels may be welded together forming horizontal members of greater strength than single channels. Members shall be Kindorf, Unistrut, or equal. Horizontal members made of Kindorf, Unistrut, or similar products shall be limited to a maximum length of eight (8) feet. Structural steel members shall be used for horizontal members exceeding eight (8) feet in length.

2. Each multiple hanger shall be designed to support a load equal to the sum of the weights of the pipes, conduits, wire, and water, the weight of the hanger itself, and 200 pounds. The size of the hanger rods shall be such that the stress at the roof of the thread will not be over 10,000 pounds per square inch at the design load. No rod shall be smaller than 3/8 inch. The size of the horizontal members shall be such that the maximum stress will not be over 15,000 pounds per square inch at design load.

3. Horizontal runs of piping and conduits along walls, four (4) inches and smaller, exposed or concealed, shall be secured to Kindorf or Unistrut support members as specified hereinbefore. Provide appropriate clamps, brackets and similar attachments to secure piping and conduits to vertical members in accordance with applicable sections of the specification.

4. Uninsulated copper lines installed on top of trapeze shall be wrapped with Unistrut Uni-Cushion elastomer material and P-2600 clamp to isolate copper from steel trapeze and pipe clamp.

H. Hanger attachments shall be suitable for each type of hanger and shall be compatible with the building materials to which it is secured. The types of attachments which shall be used for the various types of building construction encountered shall conform to the following Anvil International figures:

1. Concrete (existing) - Figs. 47, 49 or 52 attachments. Refer to drawings for specific application of individual types.
2. Steel beams - Figs. 66, 92, and 93 attachments. Refer to drawings for specific application of individual types.
3. Bar joists - Figs. 60 or 225.
4. Brick or block walls - Figs. 194, 195, 199, or 202 fastened as follows: For light duty, self-drilling anchors in brick and toggle bolts in block; for heavy duty, through bolts with backing plates.

I. Per IBC Section 1912 and ACI 318 Appendix D, all concrete anchors within the scope of ACI 318 require approved anchors for crack concrete. Attachment devices shall have certified load test data from
an independent test laboratory and shall be capable of carrying a minimum of five times the design load. The concrete anchors for the following supported items need to meet the crack concrete requirements:

1. Any suspended pipe, larger than 2”, regardless of material.
2. All components with an Ip 1.5 (example) gas lines.
3. Cable tray.
4. All components required to function after a seismic event (example) generator, emergency lightings, fire alarm and all associated conduits / panels, etc.
5. Anywhere required by ASCE 7.
6. All suspended HVAC and air distribution equipment, including supply air terminal units.

J. Pipe Shields

1. On insulated piping larger than 2”, provide equal thickness 12” long sections of calcium silicate with jacket carried continuously over calcium silicate and vapor sealed as appropriate.
2. On insulated piping 2” and smaller, provide insulation protection shield equal to Anvil International Figure 167. Shield shall comply with Manufacturers Standardization Society (MSS) SP-58 (Type 40).

K. Use 24” minimum length mineral-fiber board insulation, of specified thickness, on the bottoms of ducts at each trapeze hanger location. Refer to Section 230700 “Mechanical Systems Insulation.”

L. Gripple hangers shall be used to suspend all exposed rectangular, oval, round and spiral ductwork. Gripple hangers shall consist of a pre-formed wire rope sling with either a pre-formed ferruled loop, permanently fixed threaded stud, or permanently fixed end-stop with or without a toggle.

1. The contractor shall select the correct specification of Gripple hangers for supporting each particular service.
2. Gripple hangers shall be installed in accordance with all the manufacturer’s recommendations.

M. Welded attachments for securing hangers to piping or to structural steel may be provided in lieu of other attachments specified. Welded attachments shall be designed so that the fiber stress at any point in the weld or attachment will not exceed the fiber stress in the hanger rod.

N. All hangers shall be prime painted for interior locations and galvanized coated for exterior locations.

O. In no case shall wire or perforated strap be used for pipe or conduit support.

P. Hangers shall be provided with seismic restraints as required by IBC and ASCE 07.

Q. Vibration hangers shall be provided as hereinafter specified in Division 23, Section “Mechanical Vibration, Sound and Seismic Controls”.

2.2 IDENTIFICATION, VALVE TAGS AND CHARTS

A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

4. NFPA Standards
B. Product Data and Samples: In accordance with Division 1 Section “Submittal Procedures”, submit the following:

1. Product data sheets on all products contained in this article for approval. Data sheets must substantiate conformance with applicable standards and specification.
2. Valve Schedule that includes: Service Abbreviation, Number Sequence, Valve Location, Valve Function.

C. Pipe Markers

1. General: Pipe Markers shall comply with ANSI / ASME A13.1 2007 “Scheme for the Identification of Piping Systems” and be installed as required and indicated below using legends spelled out fully with few abbreviations and directional arrows to indicate flow. Arrows must have the same background color as the pipe marker legend, or be incorporated into the pipe marker.
3. For pipes with an overall diameter of 6” or less (including insulation), provide semi rigid plastic wrap around pipe marker that extends 360° around the pipe at each marker location. The semi rigid marker should include the legend (pipe content) and a directional flow arrow. The marker shall be supplied as a pre-tensioned device and be equipped with a ½” strip of adhesive on the inside to further secure the marker in a permanent position on vertical locations.
4. For pipes with an overall diameter greater than 6” (including insulation) provide a semi rigid plastic strap-on pipe marker with a height no less than 3 times the letter height. The marker shall include a legend (pipe content) and a directional flow arrow. The maker shall be supplied with no less than two nylon straps to secure the marker in place.

D. Valve Tags

1. General: Provide valve tags on all controlling valves installed and related to this project, except obvious drain and vent piping. Match service abbreviations with mechanical drawings.
2. Valve Tags shall be approximately 19 gauge brass and no less than 1 ½” in diameter. Tag shall be stamped and black filled with a service abbreviation and a sequential number. The service abbreviation shall be on the top line and be no less then ¼” in height. The sequential number shall be on the bottom line and shall not be less then ½” in height. If necessary, to accommodate longer abbreviations or number sequences increase tag size to 2½” in diameter.

E. Valve Tag Fasteners

1. General: Attach valve tag to the stem or body of the valve so that the tag is visible but doesn’t interfere with the valve operation.
2. Fastener: Attach each valve tag using the following products. #16 Solid Brass Jack Chain, 1-1/2” Solid Brass “S” Hooks, # 6 Solid Brass Beaded Chain.
3. Valve Schedule Frame: Install an 8 ½” x 11” aluminum valve chart frame in a conspicuous location inside each room that contains control valves. The chart should contain the following information about each tag: Service Abbreviation, Valve Number, Valve Location and Valve Function. To protect the chart, the frame should be supplied with a 10 mil clear plastic cover.

F. Equipment Nameplates

1. General: Provided an engraved multi-layered plastic laminated nameplate for all mechanical equipment purchased for this project. Provide an additional engraved nameplate for each disconnect and controller connected to the mechanical equipment.
2. Mechanical Equipment: Provide a 1/16” thick black nameplate with white letters for all mechanical equipment. The nameplate shall be a minimum of 3” high x 6” wide. The nameplate shall be engraved with the Equipment Tag as shown on the mechanical drawings and schedules. The minimum letter height shall be 3/4”. If necessary enlarge the size of the plate to accommodate
the ¾” characters. Do not reduce the letter height. The nameplate shall be installed with either double faced adhesive or with stainless steel screws.

3. Access Panels: Provide a 1/16” thick white nameplate with black letters to identify access to concealed valves or equipment such as those found above acoustical ceilings tiles. The nameplate shall be ¾” high x 2 ½” wide. Coordinate the information to be engraved on each plate so that it exactly matches the valve tag or equipment nameplate. The minimum letter height shall be ¼”. Install these nameplates on the ceiling support to the right of the tile that would provide access. Nameplates should be installed using double faced 2 mil. permanent acrylic adhesive.

G. Duct Markers

1. General: Provide pressure sensitive vinyl labels on all ductwork installed on this project to identify the basic content and directional flow of the duct. Utilize manufacturer’s standard legends such as: Exhaust, Exhaust Air, Intake, Intake Air, Outside Air, Relief, Relief Air, Return Air or Supply Air.

2. Smaller Ducts: On ducts up to 24” in size provide a duct marker that is a minimum of 2 ¼” x 16” and has a letter size of 1 ½”. Each marker must be supplied with a directional flow arrow.

3. Larger Ducts: On ducts larger than 24” in size provide a duct marker that is a minimum of 4” x 24” and has a letter height of 2 ½”. Each marker must be supplied with a directional flow arrow.

H. For supply and exhaust air terminal units located above the ceiling, in addition to a label on the device, labels are to be permanently affixed to the ceiling grid framing as near to the item as possible using epoxy glue. Where hard ceilings are used, the label is to be affixed to the frame of the access panel for the unit. Terminal units shall be identified as indicated on the mechanical drawings and ATC graphics. The thermostat that controls each air terminal unit shall be identified with an identical but appropriately sized label.

I. For fire, smoke and fire/smoke dampers located above the ceiling, labels are to be permanently affixed to the ceiling grid framing as near to the item as possible using epoxy glue. Where hard ceilings are used, the label is to be affixed to the frame of the access panel for the damper. Labels are to be black core white or beige Bakelite. The lettering is to be 3/8” inches high. The minimum label size is 3/4” wide by 1” long. Dampers shall be identified as “Fire Damper”, “Smoke Damper” or “Fire/Smoke Damper”.

J. Labels shall have minimum 3/4 inch high black letters for pipes one (1) inch and larger, and 1/2 inch letters for smaller pipes. All labels shall have flow arrows. Color coding and stencil designations shall be as follows:

<table>
<thead>
<tr>
<th>Service</th>
<th>Color</th>
<th>Label Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Water Supply</td>
<td>Yellow</td>
<td>Heating Water Supply</td>
</tr>
<tr>
<td>Heating Water Return</td>
<td>Yellow</td>
<td>Heating Water Return</td>
</tr>
</tbody>
</table>

2.3 PIPE, FITTINGS AND JOINTS

A. General: Items are referred to by type and shall conform to the standards identified.

B. All piping shall be new domestic pipe material, manufactured in the United States of America (USA) and be suitable for the specific use indicated on drawings and in the specifications.

C. Piping Material:

<table>
<thead>
<tr>
<th>Service</th>
<th>Piping</th>
<th>Fittings</th>
<th>Joints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitary Drainage and Vent</td>
<td>J</td>
<td>VIII</td>
<td>i</td>
</tr>
</tbody>
</table>
2. Heating Water Supply and Return: F III e

D. Piping Assembly:

<table>
<thead>
<tr>
<th>Type</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Seamless copper water tube, ASTM B88, Type L, hard</td>
<td>F</td>
</tr>
<tr>
<td>2. Cast iron soil pipe, service weight No-Hub, ASTM A-888. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF International.</td>
<td>J</td>
</tr>
</tbody>
</table>

E. Fitting Materials:

<table>
<thead>
<tr>
<th>Type</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Copper Press Fittings, by Rigid Tool Co. or Viega. Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.</td>
<td>III</td>
</tr>
<tr>
<td>2. Cast iron soil pipe fittings, No Hub, ASTM A-888.</td>
<td>VIII</td>
</tr>
</tbody>
</table>

F. Joint Materials:

<table>
<thead>
<tr>
<th>Type</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Press fit joining method. Joints shall be pressed using the tool approved by the manufacturer.</td>
<td>e</td>
</tr>
<tr>
<td>2. No-hub all stainless steel coupling. Stainless steel clamp, screw and corrugated shield with polychloroprene (neoprene) gasket conforming to ASTM C 564. 1 1/2&quot; through 4&quot; diameter couplings shall consist of 3&quot; wide shield with four (4) clamps. 5&quot; through 10&quot; diameter couplings shall consist of 4&quot; wide shield with six (6) clamps. Coupling shall be equal to Husky SD 4000 series.</td>
<td>i</td>
</tr>
</tbody>
</table>

2.4 VALVES

A. General:

1. Valves shall be provided where indicated on the drawings and as herein specified.
2. Valves shall be placed in such manner as to be easily accessible for hand wheel operation and stuffing maintenance.
3. Install shut-off valves in piping where shown or where listed below:

   a. To isolate all items of equipment.
   b. To isolate motorized flow control valves.
   c. To isolate branch lines at mains.

4. Valve pipe connections shall be screw, solder or weld flange as required to be consistent with
other parts of the piping system.

5. Where piping or equipment may subsequently need to be removed, provide valves with bodies having integral flanges or full lugs drilled and tapped to hold valve in place so that downstream piping or equipment can be disconnected and replaced with blank-off plate while valve is still in service.

6. Where valves specified are not available in the pipe size noted on the drawing, the next larger size valve shall be provided.

B. Balancing Valves:

1. Provide balancing valves where indicated and required to balance water flow through the piping system.

2. Balancing valves, 1-1/4 inches and larger, for systems piping shall be DeZurik as follows: PEC, flanged above two (2) inches with Buna filled PTFE U-ring seal and isobutene-isoprene plug facing, suitable for 250 degrees Fahrenheit continuous operation. Valves in chilled water systems may have seal and plug facing suitable for 180 degrees Fahrenheit. Valves six (6) inches and smaller shall have lever actuators and valves eight (8) inches and larger shall have gear operators. All actuators shall have adjustable memory stops.

3. Balancing valves one (1) inch and smaller shall be Armstrong Model CBV or as manufactured by TA Hydronics or approved equal.

C. Ball Valves:

1. Ball valves shall be used in all water systems size two (2) inches and smaller.

2. Ball valves shall be Nibco, Jamesbury, Apollo or Watts.

3. Two (2) piece ball valves sizes 1/2 inch to two (2) inch may be used for HVAC piping systems where replacement of internal parts is not critical. Valves shall be equal to Nibco Figure No. 585-66, bronze body, full port, stainless steel ball and stem (ASTM A-276, Type 316), TFE seat, blowout proof stem, extended stem for insulation thickness, and suitable for 150 pounds per square inch saturated steam service.

4. Valves shall be equipped with lever handle with extended stem for insulation thickness which shall indicate position of ball orifice and have stops for fully open and closed position. Construction shall be such that power actuator can be used. Ball opening shall be full pipe size.

5. Valve shall be suitable for flow in either direction and must be leak proof at all pressures up to 150 pounds per square inch gauge (psig) and temperatures from minus twenty (-20) degrees Fahrenheit to 350 degrees Fahrenheit in open or shut position.

D. Drain Valves:

1. Drain valves shall be ball type as hereinbefore specified with hose end adapter and shall be provided at low points of all piping systems, and where indicated, 3/4 inch minimum.

2.5 PIPING SPECIALTIES

A. Manual Air Vents:

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

   a. AMTROL, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump.
   d. Nexus Valve, Inc.
   e. Taco, Inc.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 225 deg F.

B. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel with perforations as follows:
   a. Water Service up to 2 inches: 20-mesh strainer

C. Install wells in heating water piping for automatic temperature control sensors. Exact locations and number of wells required shall be determined through coordination with the work required under Division 23, Section "Building Automation and Temperature Control System".

2.6 TEST PLUGS
A. Pressure and temperature test plugs where indicated or required shall be 1/4 inch npt fittings, suitable to receive either a 1/8 inch outside diameter (OD) temperature or pressure probe. Fittings shall be solid brass with Nordel valve core, fitted with a color coded marked cap with gasket. The entire assembly shall be rated at 1000 pounds per square inch gauge (psig). Plugs shall be manufactured by Peterson Equipment Company, Inc., Richardson, Texas, or Sisco P/T plugs.

2.7 DIELECTRIC FITTING
A. Joining of two dissimilar metals shall be by a brass union, suitable for system fluid, pressure, and temperature.

2.8 MISCELLANEOUS MATERIALS FOR SUPPORTS, HANGERS, ANCHORS AND GUIDES
A. The Contractor shall provide all miscellaneous materials required to properly install all supports, hangers, anchors and guides, including:
   1. Steel Plates, Shapes and Bars: Provide products complying with ASTM A36.
   2. Cement Grout: Portland Cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
   3. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.
PART 3 - EXECUTION

3.1 CLEANING, FLUSHING, INSPECTING

A. General: Clean exterior surfaces of piping systems of superfluous materials, and prepare for application of specified coatings (if any.) Clean interior of pipe by mechanical means to remove welding slag, metal filings, dirt, and debris. Flush out piping systems to the satisfaction of the Owner before proceeding with required tests. Inspect each run of each system for completion of joints, supports, and accessory items.

1. Inspect Building Services Piping in accordance with procedures of ASME B31.9.

B. Any damage to existing or new equipment or components shall be repaired or replaced at the Contractor’s expense to the satisfaction of the Owner.

C. The Contractor shall clean and flush all installed piping systems with a clean water solution with additives formulated to assist in the removal of welding slag, metal filings, oil, and grease. Flushing operations shall maintain a minimum velocity of six feet per second for a minimum four hour time frame. Repeat flushing operations to the satisfaction of the Owner and until flushing water is completely clear. System pumps may be utilized for flushing operations with fine mesh start-up screens. Clean screens often and replace with final system screens at completion of flushing operations. The Contractor shall provide all temporary equipment and piping necessary to complete the flushing operations.

D. Refill and vent water systems being sure to add water after venting to completely fill system.

E. Provide water treatment services as indicated in other Division 23 specification Sections.

3.2 PIPING INSTALLATION

A. Install piping without undue stress or strain in locations shown and run parallel to the lines of the building, except to grade them as specified in neat and workmanlike manner using a minimum of fittings. Provide such fittings, valves and accessories as may be required to meet the conditions of installation. Contractor shall inform himself fully regarding any peculiarities and limitations of space available for installation of material under each section of specifications. Install piping to suit necessities of clearance with ducts, conduits, and other work, and so as not to interfere with any passages or doorways and allow sufficient head room at all places. Use proper reducing fittings for changing piping sizes.

B. Cut pipes accurately to measurements established in the field in a neat and workmanlike manner without damage or without forcing or springing. Perform cutting by means of an approved type of mechanical cutter of the wheel type where practicable. Ream pipe after cutting to remove all burrs.

C. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories that may be required. Carefully investigate the architectural and structural conditions affecting the work, and arrange such work accordingly, providing such fittings, and accessories as may be required to meet such conditions. Drawings (plans, schematics, and diagrams) indicate the general location arrangement and restrictions of the piping systems. Location and arrangement of piping layout shall take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated on the Contract Drawings unless deviations to layout are approved on the Coordination Drawings. The Contract Drawings are diagrammatic in nature and are not welding fit-up documents. The Contractor is responsible for a complete installation. Refer to individual system specifications for requirements for coordination drawing submittals.

D. Install at low points of gas piping and at the foot of each riser and each drip, a "T" fitting and six (6) inch
long capped drip pocket of same size and riser or drip. Grade horizontal gas pipe to prevent traps. Pipe all green gas vents to the exterior as required by Code. Make all joints with graphite and oil and in accordance with National Fuel Gas Code requirements.

E. Install unions and flanges where shown and on each side of all pieces of equipment and other similar items, and in such a manner that the unions can be readily disconnected. Do not place any union or flange in a location which will be inaccessible after completion of the project unless so shown on drawings or specified.

1. Unions in steel pipe 2-1/2 inches and smaller, shall be 250 pound malleable iron, brass seat type. Use 150 pound forged steel flanges for piping three (3) inches and larger. Gaskets shall be 1/8 inch thick. Unions in copper pipe two (2) inches and smaller shall be wrought copper with red bronze ring nut. Use 150 pound ASME copper flanges for piping 2-1/2 inches and larger. Use dielectric unions or couplings where nonferrous metal is joined to ferrous metal.

F. Use reducing fittings, eccentric where required to prevent pocketing of air and water or both, to make changes to pipe sizes.

G. HVAC piping shall be installed plumb, level, and square with low point drains and high point vents. Steam, condensate, drain and sanitary waste and vent piping shall be sloped per code.

H. Contractor shall fully coordinate the installation of all piping systems with all other trades including sheet metal, electrical, sprinkler, ceiling systems, etc.

3.3 IDENTIFICATION

A. All surfaces that are to receive adhesive applied mechanical identification such as Pipe, Duct, and Equipment nameplates should be clean and dry prior to application.

B. Pipe Markers:

1. Identify all piping on this project as described, except piping which is not accessible.
2. Identify piping concealed by ceiling tiles, floor tiles and, crawl spaces.
3. Only piping located within walls or inaccessible areas need not be identified.
4. Install pipe markers on long straight runs every 20 feet.
5. Install pipe markers on either side of every wall penetration and, insure there is at least one marker per pipe in every room.
6. Install pipe markers at every valve, branch and, any change in piping direction.
7. Install pipe markers so they are visible for a normal standing position.

C. Valve Tags:

1. Identify all valves on this project as described except drain lines. Attached tags using solid brass chain and “S” hooks so they are easily visible but do not obstruct the operation of the valve.
2. Provide a valve schedule to the engineer for approval. After schedule is approved install an aluminum frame in every room containing valves and installed the approved valve schedule detailing the valves within each room.

D. Equipment Nameplates:

1. Identify all equipment, the location of concealed equipment and the disconnects and controls of all equipment as described. Attach these nameplates with double faced 2 mil permanent acrylic adhesive.
E. Duct Markers:

1. Install duct markers every 20 feet on long straight runs.
2. Install duct markers at all wall penetrations and near all connected equipment.
3. Install duct markers at all branches and changes in direction of the duct so it is easily traced.

3.4 JOINTS

A. Non-Ferrous Pipe Joints:

1. Press Fitting: Copper press fitting joints shall be made in accordance with the manufacturer’s installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.
3. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

B. Hubless Cast-Iron Joints: Comply with coupling manufacturer’s installation instructions.

3.5 WORKMANSHIP

A. Cut pipes accurately to measurements established at structure. Install pipes without springing or forcing.

B. Clear windows, doors, and other openings with all pipes and ductwork.

C. Arrange pipes to permit expansion and contractions without misalignment or damage.

D. During construction all openings in piping and equipment shall be closed with caps or plugs to keep out all foreign matter and to prevent leakage.

E. All piping in finished spaces shall be run concealed unless otherwise indicated.

3.6 TESTS

A. The following tests shall be conducted by the Contractor and all piping shall be proven tight in the presence of the Owner, Architect and/or his representative. Provide minimum 48 hours notice prior to testing. These tests shall be conducted before any insulation is installed and any insulation installed prior to tests shall be removed. Provide all equipment and labor required. Tests shall be at least four (4) hours in duration, after all piping has been proven tight. Piping may be tested in sections as approved by the Architect. Tests shall be as specified herein and a written test report shall be submitted to the Architect within two (2) days following each individual test. All test reports shall be included in the operation and maintenance manuals.

B. The sanitary and miscellaneous drain systems shall be hydrostatically tested. Tests shall be as required by code and as a minimum shall comprise of the plugging of all openings in the lines, filling the system (or portion thereof), with water until all joints are proven tight. Piping shall be tested with a minimum head
of ten (10) feet of water.

C. All heating water piping shall be hydrostatically tested to 1-1/2 times the system working pressure or a minimum of 100 pounds per square inch gauge (psig), whichever is greater.

D. All heating water piping systems shall be filled with water and thoroughly flushed clean of foreign matter after erection and before connection of equipment.

E. After heating water systems have received their final filling, employ a qualified water testing laboratory to analyze the water and to provide proper treatment to bring the pH to a level between 6.5 and 7.25. Furnish three (3) certified copies of the test report to Architect. Include the test report data, water analysis, any treatment provided for initial treatment, and recommended type of continuous treatment to be provided for the make-up water to the systems.

3.7 MOLD AND CONDENSATION PREVENTION

A. Piping Systems: Cold piping systems (such as cold water) shall not be operated prior to insulation and vapor barrier installation in order to prevent condensation on the piping.

B. Air Systems: Air handling systems shall not be operated at supply air temperatures below fifty (50) degrees F and all supply air ductwork shall be insulated prior to operation. Coils shall be insulated to prevent condensation when heating valve is closed. Air systems shall not be operated in portions of the building not yet fully enclosed, where systems can be exposed to warm, humid air conditions.

C. Room thermostats shall not be set lower than sixty-eight (68) degrees F. Programmable thermostats shall be set to prevent lower temperature setting from the exterior of the thermostat by room occupants.

D. Contractor shall notify the Architect immediately if signs of condensation or mold are discovered.

END OF SECTION 230530
SECTION 230548 - MECHANICAL VIBRATION, SOUND AND SEISMIC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, General Requirements and all other Specification Sections apply to the work specified in this section.

B. The International Building Code and SEI/ASCE 07 Standard apply to all work associated with the seismic installation of all new mechanical and electrical equipment.

1.2 SUMMARY

A. This Section includes the following:
   1. Elastomeric hangers.
   2. Spring hangers.
   3. Restraining cables.

B. This section includes requirements for items of equipment, materials and procedures which are common to more than one section of Division 23.

1.3 DEFINITIONS

A. Aₚ: Effective peak velocity related acceleration coefficient.

B. OSHPD: Office of Statewide Health Planning & Development for the State of California. OSHPD assigns a unique anchorage preapproval "R" number to each seismic restraint it tests. The number describes a specific device applied as tested.

C. Positive Attachment: A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.

D. Transverse Bracing: Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.

E. Longitudinal Bracing: Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

F. Failure: For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8" and/or horizontal permanent deformation greater than 1/4".
1.4 SUBMITTALS

A. Product data.

B. Shop Drawings: Signed and sealed by the manufacturer’s qualified professional engineer. Before ordering any products, submit shop drawings of the items listed below. The shop drawings must be complete when submitted, be based on equipment actually purchased and must be presented in a clear, easily understood form. Incomplete or unclear presentation of shop drawings may be reason for rejection of the submittal. Include the following:

1. Product Description: A complete description of products to be supplied, including product data, dimensions, specifications, and installation instructions.
2. Selection Data: Detailed selection data for each vibration isolator supporting equipment, including:
   a. Equipment identification mark;
   b. Isolator type;
   c. Actual load;
   d. Static deflection expected under the actual load
   e. Specified minimum static deflection.
3. Design Calculations: Calculate requirements for selecting seismic restraints. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by the manufacturer's registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
4. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
7. Provide Approved Agencies Certificate of Compliance meeting Seismic Category D for all components. Tests shall include anchorage, structural and on line capability from analytical or shaker test method.

C. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 MANUFACTURER RESPONSIBILITIES

A. Manufacturer of seismic restraint equipment shall have the following responsibilities:

1. Determine seismic restraint sizes and locations.
2. Provide seismic restraints as scheduled or specified.
3. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
4. Provide certification by a licensed engineer employed by the manufacturer that all restraints meet the project requirements for seismic loading.

1.6 RELATED WORK

A. Supplementary Steel

1. Provide any incidental materials and supplementary support steel for all equipment, piping, ductwork, roof mounted equipment, etc., such as mounting brackets, attachments and other accessories, that may be needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, at no additional cost.

B. Attachments

1. Contractor shall supply restraint attachment plates cast into concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the vibration vendor’s calculations.

1.7 QUALITY ASSURANCE

A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "R" number, from OSHPD or 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. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.


C. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

D. Upon completion of the work, the Architect shall inspect the installation and shall inform the installing contractor of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers:
   1. Amber/Booth Company, Inc.
   2. B-Line Systems, Inc.
   3. California Dynamics Corp.
   5. Loos & Co., Inc.; Cableware Technology Division.
   6. Mason Industries, Inc.
   7. TOLCO Incorporated.
   8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
   10. Vibration Isolation Co., Inc.

B. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 40, plus or minus 5, with a flat washer face.

C. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 40, plus or minus 5.

D. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

E. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

F. General Requirements:
   1. Equipment, piping, ductwork, conduit, lighting and electrical devices shall be braced and supported in accordance with International Building Code.
   2. This Contractor shall provide the services of a professionally registered Seismic consultant to perform duties indicated below. The Contractor shall submit with his bid, the hourly billing rate for their Seismic consultant to provide additional services beyond the specified scope.

G. HVAC Ductwork:
   1. Attachments and supports for HVAC ductwork systems shall be designed to meet the force and displacement provisions of SEI/ASCE 7 Standard.

H. Piping
   1. Attachments and supports for piping systems shall be designed to meet the force and displacement provisions of SEI/ASCE 7 Standard.

I. Mechanical Equipment, Attachments and Supports
   1. Attachments and supports for mechanical equipment shall be designed to meet the force and
displacement provisions of SEI/ASCE 7 Standard.

J. Seismic details indicated on the drawings are not intended to limit the Contractor. Alternated methods of support, attachment and bracing must be designed by the Seismic Consultant and submitted to the Architect for review.

2.3 RESILIENT PENETRATION SLEEVE/SEAL

A. Resilient penetration sleeve/seals shall be field-fabricated from a pipe or sheet metal section that is 1/2 inch to 3/4 inch larger than the penetrating element in all directions around the element, and shall be used to provide a sleeve through the construction penetrated. The sleeve shall extend one (1) inch beyond the penetrated construction on each side. The space between the sleeve and the penetrating element shall be packed with glass fiber or mineral wool to within 1/4 inch of the ends of the sleeve. The remaining 1/4 inch space on each end shall be filled with acoustical sealant to form an airtight seal. The penetrating element shall be able to pass through the sleeve without contacting the sleeve. Alternatively, prefabricated sleeves accomplishing the same result are acceptable.

2.4 RESILIENT LATERAL SUPPORTS

A. These units shall either be a standard product of the vibration isolation mounting manufacturer, or be custom fabricated from standard components. These units shall incorporate neoprene isolation elements that are specifically designed to provide resilient lateral bracing of ducts or pipes.

2.5 FLEXIBLE PIPE CONNECTIONS

A. Flexible pipe connections shall be fabricated of multiple plys of nylon cord, fabric, and neoprene; and shall be vulcanized so as to become inseparable and homogeneous. Flexible connections shall be formed in a double sphere shape, and shall be able to accept compressive, elongating, transverse, and angular movements.

B. The flexible connections shall be selected and specially fitted, if necessary, to suit the system temperature, pressure, and fluid type. In addition, suitable flexible connections should be selected which do not require rods or cables to control extension of the connector.

C. Connectors for pipe sizes two (2) inches or smaller shall have threaded female union couplings on each end. Larger sizes shall be fitted with metallic flange couplings.

2.6 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be electrogalvanized. Hot-dip galvanized metal components for exterior use.
3. Baked enamel for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.
PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine areas and equipment to receive seismic-control devices for compliance with requirements, 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 APPLICATION:
   A. General:
      1. Refer to the PRODUCTS section of this specification for devices identified on the drawings or specified herein.

3.3 INSTALLATION
   A. General:
      1. Locations of all seismic devices shall be selected for ease of inspection and adjustment as well as for proper operation.
   B. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackles piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
   C. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.
   D. Install resilient bolt isolation washers on equipment anchor bolts.

3.4 FIELD QUALITY CONTROL
   A. Testing: Perform the following field quality-control testing:
      1. Isolator seismic-restraint clearance.
      2. Isolator deflection.
      3. Snubber minimum clearances.

3.5 ADJUSTING
   A. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
3.6 CLEANING

A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

3.7 SEISMIC INSTALLATION INSPECTION

A. On completion of installation of all vibration isolation and seismic restraint devices herein specified, a representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation errors, improperly selected isolation or restraint devices, or other faults that could affect the performance of the system. Contractor shall submit a report to the Architect, including the manufacturer's representative’s final report, indicating all isolation reported as properly installed or requiring correction, and include a report by the Contractor on steps taken to properly complete the isolation work.

B. All special inspections must be performed in accordance with IBC and as specified herein.

END OF SECTION 230548
SECTION 230593 - TESTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, General Requirements and all other Specification Sections apply to the work specified in this section.

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Air Systems:
   a. Variable-air-volume systems.

2. Hydronic Piping Systems:
   a. Variable-flow systems.

3. HVAC equipment quantitative-performance settings.
4. Verifying that automatic control devices are functioning properly.
5. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. NC: Noise criteria.

E. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

F. RC: Room criteria.

G. Report Forms: Test data sheets for recording test data in logical order.

H. TAB: Testing, adjusting, and balancing.

I. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

J. Test: A procedure to determine quantitative performance of a system or equipment.
K. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 QUALIFICATIONS

A. Work included in this section must be performed by an independent testing and balancing agency, certified by either AABC or NEBB, who shall provide a complete and comprehensive total system balance process to test, adjust, and balance the air and water systems for this project.

B. All work shall be performed under direct supervision of a qualified engineer. All instruments used shall be accurately calibrated and maintained in good working order. If requested, calibration tests of equipment to be used shall be performed in the presence of the Architect.

C. Submit for review and approval the names of the personnel who will be responsible for the work and those who will actually perform the testing and balancing and their qualification, which shall demonstrate that they have balanced and tested systems of comparable size and complexity.

1.5 SUBMITTALS

A. Qualification Data: Submit evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.


D. Certified TAB Reports: Submit reports prepared, as specified in this Section, on approved forms certified by TAB firm.

E. Warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.


D. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" and NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by the instrument manufacturer.
   1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.7 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.9 WARRANTY

A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents.

C. Guarantee includes the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

1.10 TEST PROCEDURE

A. System may be tested in sections when approved by the Architect.

B. When testing and balancing involve the building temperature control systems, cooperate with the temperature control subcontractor to achieve the desired results.

C. At the time of final inspection, recheck in the presence and at the request of the Architect not to exceed ten (10) percent of the previously recorded readings from the certified report selected at random from the log by the Architect.
D. Permanently mark the settings of valves, dampers, and other adjustment devices so that adjustment can be restored if disturbed at any time. Do not permanently mark devices before final acceptance.

E. Perform all tests in accordance with AABC standard procedures. Any deviation from same must be approved by the Architect.

F. Should the basic system or any of its components fail to meet contract requirements, and thereby make the testing and balancing work invalid, notify the Architect and stop all tests until such time that the failure is corrected.

PART 2 - PRODUCTS

2.1 TEST INSTRUMENTS


B. Instruments used for balancing air and water systems must have been calibrated within a period of six (6) months prior to balancing.

C. List in the report types, serial numbers, and dates of calibration of all instruments used in the final air and water balance tests.

D. Instrumentation shall include, as a minimum, the following items of equipment:

1. Pressure gauges and fittings.
2. Dry bulb and wet bulb thermostats.
3. Contact pyrometer.
4. Portable flow meter and, if required, orifice plates.
5. Pitot tube and manometers.
6. Alnor Velometer with attachments.
7. Amprobe.
8. Tachometer.
9. Special wrenches and tools.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.
C. Examine project record documents described in Division 1 Section "Project Record Documents."

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine supply and exhaust air terminal units to verify that they are accessible and their controls are connected and functioning.

L. Examine strainers for clean screens and proper perforations.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine equipment for installation and for properly operating safety interlocks and controls.

O. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices are operated by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions.
   4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
   5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   6. Sensors are located to sense only the intended conditions.
   7. Sequence of operation for control modes is according to the Contract Documents.
   8. Controller set points are set at design values.
   9. Interlocked systems are operating.
   10. Changeover from heating to cooling mode occurs according to indicated values.
P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   8. Windows and doors can be closed so indicated design conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. All air distribution systems including supply, return and exhaust ductwork shall be tested and balanced.

B. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

C. Prepare schematic diagrams of systems' "as-built" duct layouts.

D. For variable-air-volume systems, develop a plan to simulate diversity.

E. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
F. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

H. Verify that motor starters are equipped with properly sized thermal protection.

I. Check dampers for proper position to achieve desired airflow path.

J. Check for airflow blockages.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

M. Where the system cannot be properly balanced or equipment tested due to system deficiencies such as inability to properly adjust fan speeds, improperly sized motors, excessively noisy equipment, malfunctioning controls, excessively out of balance air distribution system branch runs, and similar items, furnish to the Architect in writing a list of the deficiencies prior to the submission of the test report.

N. Verify operation of each room thermostat serving variable air volume terminal units over full range of heating and cooling to insure proper sequence of control of the variable air volume operator and reheat coil valve.

O. Field test maximum and minimum air volumes of all variable air volume terminal units and record final settings. Check factory settings of regulators and controllers before tests. Reset to the scheduled air volumes if required.

P. Work in conjunction with the Automatic Temperature Control Contractor and Architect to establish maximum and minimum settings on all variable air volume fans.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by the fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

   a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

   b. Measure static pressure directly at the fan outlet or through the flexible connection.

   c. Measure the inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and treating equipment.

   a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery
equipment, and air washers under final balanced conditions.

4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.

6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

   a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure
static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge duct losses.

3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

   a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure adequate static pressure is maintained at the most critical unit.

8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

   1. Open all manual valves for maximum flow.
   2. Check flow-control valves for specified sequence of operation and set at indicated flow.
   3. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
   4. Set system controls so automatic valves are wide open to heat exchangers.
   5. Check air vents for a forceful liquid flow exiting from vents when manually operated.

D. Where liquid flow balancing cannot be accomplished due to system deficiencies such as excessive or lack of pumping head, inadequately sized motors, pressure drops not determinable or similar problems, prepare a list of such deficiencies and the suggested system modifications and furnish to the Architect in writing and prior to submission of test report for necessary action.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

A. Set calibrated balancing valves, if installed, at calculated presettings.
B. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

C. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.

D. Adjust balancing stations to within specified tolerances of design flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.

E. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.

F. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 GENERAL PROCEDURES FOR EQUIPMENT

A. Conduct performance tests only after the air and water systems have been balanced and the proper flow rates established.

B. Test and record capacity of heat transfer equipment including all coils. Air side and water side capacities must agree within five (5) percent of each other. Include the manufacturer's rated capacity at the test operating conditions with the report. Perform tests where possible at design conditions. If tests are not performed under design conditions, interpolate results to determine capacity at full load operating conditions.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:
   1. Entering- and leaving-water temperatures.
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry-bulb temperatures of entering and leaving air.
   5. Wet-bulb temperatures of entering and leaving air for cooling coils.
   6. Airflow.
   7. Air pressure drop.
3.12 PROCEDURES TEMPERATURE TESTING

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.13 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.14 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.
3.15 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:
   1. Manufacturers' test data.
   2. Field test reports prepared by system and equipment installers.
   3. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of TAB firm.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   9. Signature of TAB firm who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents, including the following:
       a. Indicated versus final performance.
       b. Notable characteristics of systems.
       c. Description of system operation sequence if it varies from the Contract Documents.
   12. Nomenclature sheets for each item of equipment.
   13. Data for terminal units, including manufacturer, type size, and fittings.
   14. Notes to explain why certain final data in the body of reports varies from indicated values.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of outside, supply, return, and exhaust airflows.
   2. Water flow rates.
   3. Duct, outlet, and inlet sizes.
   4. Pipe and valve sizes and locations.
   5. Terminal units.

F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
   a. System and air-handling unit number.
   b. Location and zone.
   c. Traverse air temperature in deg F.
   d. Duct static pressure in inches wg.
   e. Duct size in inches.
   f. Duct area in sq. ft.
   g. Indicated airflow rate in cfm.
   h. Indicated velocity in fpm.
   i. Actual airflow rate in cfm.
   j. Actual average velocity in fpm.
   k. Barometric pressure in psig.

G. Air-Terminal-Device Reports:

1. Unit Data:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Test apparatus used.
   d. Area served.
   e. Air-terminal-device make.
   f. Air-terminal-device number from system diagram.
   g. Air-terminal-device type and model number.
   h. Air-terminal-device size.
   i. Air-terminal-device effective area in sq. ft.

2. Test Data: (Indicated and actual values):
   a. Airflow rate in cfm.
   b. Air velocity in fpm.
   c. Preliminary airflow rate as needed in cfm.
   d. Preliminary velocity as needed in fpm.
   e. Final airflow rate in cfm.
   f. Final velocity in fpm.
   g. Space temperature in deg F.

H. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Room or riser served.
   d. Coil make and size.
   e. Flowmeter type.

2. Test Data: (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Entering-water temperature in deg F.
   c. Leving-water temperature in deg F.
   d. Water pressure drop in feet of head or psig.
   e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

I. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.16 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.

2. Randomly check the following for each system:
   a. Measure airflow of at least 10 percent of air outlets.
   b. Measure water flow of at least 5 percent of terminals.
   c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
   d. Measure sound levels at two locations.
   e. Measure space pressure of at least 10 percent of locations.
   f. Verify that balancing devices are marked with final balance position.
   g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.

2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.

3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.

7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.
3.17 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 230593
SECTION 230700 – MECHANICAL SYSTEMS INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, General Requirements and all other Specification Sections apply to the work specified in this section. In the event of conflict between specific requirements of the documents, the more restrictive, the more extensive (i.e. more expensive) requirements govern.

1.2 SCOPE
A. Work included in this section is the thermal insulating done in the field, on the mechanical systems as specified herein.
B. Work excluded in this Section are the following:
   1. Thermal building insulation.
   2. Sound absorbing duct lining.
C. The requirements of Division 23, Section “Mechanical and Electrical General Provisions” shall apply to the work specified under this Section.

1.3 DEFINITIONS
A. The k factor means the number of British thermal units of heat transmitted per (sq. ft.) (Fahrenheit temperature difference) through a material with flat, parallel sides one (1) inch apart. The material shall be tested and rated according to ASTM Test Method C-177.
B. Unless otherwise specified, the term "concealed", as used in this specification, shall include all items hidden from normal sight. This includes items within furred spaces, pipe and duct shafts, above suspended ceilings and within return air plenums.
C. Unless otherwise specified, the work "exposed" shall refer to all work other than "concealed" work.
D. Unless otherwise specified, the term "exterior", as used in this specification, shall include all items being or situated outside. Items located within a crawl space shall be considered exterior.
E. Unless otherwise specified, the term "conditioned", as used in this specification, shall be a heated or cooled space, or both, within a building and, where required, provided with humidification or dehumidification means, so as to be capable of maintaining a space condition falling within the comfort envelope set forth in ASHRAE 55.

1.4 SUBMITTALS
A. Provide shop drawings in accordance with Division 23, Sections “Mechanical and Electrical General Provisions” and the General Requirements which shall include all insulation, jackets, finishes, corner beads, pump covers, etc. Shop drawings shall additionally describe each system or component to be
insulated, insulation type and thickness, and method of installation.

B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.
PART 2 - PRODUCTS

2.1 GENERAL

A. All insulating materials, including adhesives, jackets and coatings, to be used on the project must be delivered to the building in the manufacturer's unopened container and must bear the manufacturer's stamp or label giving name of manufacturer, brand and description of material.

B. After the necessary tests have been conducted to prove the water and air systems tight, all piping, ductwork and equipment to be insulated shall be thoroughly cleaned and then covered. Insulation materials shall be the product of Owens Corning, CSG, Schuller or Armacell equal to the products specified herein.

C. All Insulation shall have ASTM E84 flame spread/smoke developed indices of ≤25/50 for use in air plenums of commercial buildings.

2.2 TYPES OF INSULATION

A. Type I - Pipe Insulation:

1. Provide heavy density fiberglass pipe insulation with vapor barrier jacket. The k factor shall not be more than 0.23 at seventy-five (75) degrees Fahrenheit mean temperature. Insulation shall be equal to Johns Manville Micro-Lok meeting ASTM C 547 with FSK jacket.

B. Type IV - Duct Insulation:

1. Provide blanket type lightweight fiberglass duct insulation with vapor barrier facing. The compressed k-factor shall not exceed 0.27 at seventy-five (75) degrees Fahrenheit mean temperature and a minimum installed R-Value of 6.0 (hr•ft²•°F)/Btu. Fiberglass blanket insulation shall have a minimum density of 1.5 pounds per cubic foot. Insulation shall be equal to Johns Manville flexible fiberglass blanket Microlite XG Formaldehyde-free Type 100 meeting ASTM C 553 with factory-applied FSK facing.

2.3 ADHESIVES, SEALERS AND COATINGS

A. The vapor barrier on all insulation systems shall be maintained at all times. Any penetration into the vapor barrier shall be sealed vapor tight. All joints, fittings etc shall be sealed vapor tight.

B. 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. They shall not corrode, soften or otherwise attach such material in either the wet or dry state and must be suitable for the service temperatures.

C. Any cement, sealer or coating used shall be resistant to vermin and mold and shall be durable. It shall not discolor on aging; and where applied on the final surface of the insulation, it shall be light in color and be capable of being painted.

D. For indoor applications:

1. Use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Adhesives, coatings and compounds shall be equal to the following:

1. Vapor barrier adhesive for sealing joints on pipe and duct insulation - Foster 85-75.
2. Adhesive for installing duct insulation - Foster 85-20 and 81-91.
3. Adhesive for installing elastomeric insulation - Foster Brand 85-75, Armaflex 520.
5. Adhesive for ASJ, FSK and PVDC jackets - Foster Brand 85-50, Childers CP-82.
6. FSK and metal jacket flashing sealants - Foster Brand 95-44, Childers CP-76.
7. ASJ, vinyl, PVDC, and PVC jacket flashing sealants - Childers Brand CP-76

2.4 FITTING AND VALVE COVERS

A. Pipe fittings and valves shall be insulated with one (1) piece pre-molded high impact PVC insulated fitting covers with factory precut insulation inserts and accessories. Fittings shall have edges of one (1) piece cover sealed with vapor barrier pressure sensitive tape. Fitting covers shall be 25/50 rated to meet meet fire and smoke safety requirements of federal, state and local building codes. Manufacturers shall be Knauf (Proto LoSmoke), Johns Manville (Zeston), Speedline (SmokeSafe), Thomas Insulation or equal to Proto Fitting Cover System.

2.5 METALLIC COMPONENTS

A. Staples shall be outward clinching type of 304 or 316 stainless steel.

B. Bands shall be galvanized steel, aluminum, brass, or nickel-copper alloy, of 3/4 inch nominal width. The band thickness, exclusive of coating, shall be not less than 0.005 inch for steel and nickel copper alloy, 0.007 inch for aluminum, and 0.01 inch for brass.

C. Wire shall be fourteen (14) gauge, nickel-copper alloy or copper clad steel, or sixteen (16) gauge, soft annealed, galvanized steel.

D. Wire netting used for exposed surfaces of insulation that is to be cement finished shall be twenty-two (22 gauge, one (1) inch galvanized mesh, with continuous twenty-six (26) gauge galvanized steel corner beads having 2-1/2 inch wings.

E. Protect external corners on insulation of ducts and equipment exposed in occupied spaces by corner beads two (2) inches by two (2) inches, .016 inch thick aluminum adhered to heavy duty Kraft paper.

2.6 INSULATION SCHEDULE:


<table>
<thead>
<tr>
<th>Service</th>
<th>Type</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Water Supply and Return</td>
<td></td>
<td></td>
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PART 3 - EXECUTION

3.1 GENERAL:

A. All insulation shall be installed by skilled workmen regularly engaged in this type of work.

B. Insulation shall be continuous at all hangers, hanger rods, supports, sleeves and openings. Continuous vapor barrier must be provided for all cold surfaces. Insulation shall be sealed where it terminates because of a valve, union, flange, etc.

C. Provide continuous insulation and jacketing when passing thru interior wall, floor, and ceiling construction.

1. At Through Penetration Firestops: Coordinate insulation densities with the requirements of approved firestop system being installed. Refer to Division 7, Section “Through Penetration Firestop Systems”.
2. Insulation densities required by approved firestop system may vary with the densities specified in this Section. When this occurs use the higher density insulation.

D. Do not intermix different insulation materials on individual runs of piping or ductwork.

E. Arrange to permit expansion and contraction without causing damage to insulation or surface.

F. Actual insulation thickness must be at least equal to the minimum specified in the schedule at all locations including supports in contact with cold surfaces. Where the manufacturer’s rated or nominal thickness is less than the minimum specified, a thicker material or more layers will be requested so that the stated minimum thickness will be attained or exceeded.

G. Install insulation materials in a first class manner with smooth and even surfaces. Scrap pieces of insulation shall not be used where a full length section will fit.

H. Unless otherwise specified herein, the application of all insulation materials, accessories and finishes shall be in accordance with the manufacturer's published recommendations.

I. Insulation materials shall not be applied until all surfaces to be covered are clean and dry; all foreign material, such as rust, scale, dirt, etc., has been removed, and where specified, surfaces have been painted. Insulation shall be clean and dry when installed and during the application of any finish. The insulation on pipe fittings, valves and pipe joints shall not be installed before the piping is tested and approved.

J. Omit insulation of the following unless directed otherwise.

1. Components within factory preinsulated HVAC equipment.
2. Factory - preinsulated flexible ductwork and HVAC equipment.

K. Replace and repair insulation disturbed by testing and balancing procedures required under Division 23, Section “Testing and Balancing”.

3.2 PIPE INSULATION

A. Insulate all valves and strainers. Use premolded covers and factory precut insulation where applicable. Unions and flanges shall not be insulated except on cold services.

B. Insulate valves up to and including bonnets, except for cold water valves which shall be insulated over packing nuts in a manner to permit removal for adjustment and repacking.

C. Insulate strainers in a manner to permit removal of the basket without disturbing the insulation of the strainer. Obtain (Architect's/Engineer's) approval of installation method.

D. Application - Type I Insulation:

1. Insulate all pipes in a neat and workmanlike manner. Seal all longitudinal laps of jackets and staple every six (6) inches. Where the piping operates below ambient temperature, the staples shall be coated with vapor barrier adhesive. All butt joints shall be wrapped with a three (3) inch minimum wide strip of jacketing material securely sealed in place.

2. Insulate valves and fittings with pre-cut blanket type fiberglass insulation and PVC covers as specified. Insulation shall be of the same thickness as that on adjoining pipe. The ends of the insulation shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe covering tufted and tucked, fully insulating the pipe fitting. The one (1) piece PVC fitting cover shall then be secured by stapling, tack fastening, banding or taping the ends to the adjacent pipe covering. The circumferential edges of cover shall be wrapped with ZESTON vapor barrier pressure sensitive color matching tape. The tape shall extend over the adjacent pipe insulation and overlap itself at least two (2) inches on the downward side.

3. Where fittings are operating above ambient they may, in lieu of the proceeding paragraph, be covered with a three (3) hour, hydraulic setting, combination insulating and finishing cement having k factor not greater than 0.87 at a mean temperature of 200 degrees Fahrenheit. The thickness of this cement shall be such that the surface is substantially flush with the pipe covering. Where the insulation terminates at a fitting that is not covered, the end of the insulation shall be beveled off with this same cement. All fittings insulated in this manner shall be covered by a fabric jacket as specified, which shall be cemented down with lagging adhesive.

4. Where expansion joints are required to be insulated, they shall be covered with readily removable sections of insulation of same composition and thickness as provided for adjacent piping.

3.3 DUCT INSULATION

A. Provide accessories as required to prevent distortion and sagging of duct insulation. Provide welded pins, adhesive clips and wire ties as recommended by the manufacturer and directed by the Architect.

B. Insulation shall cover all standing seams and metal surfaces. Provide corner beading on all exposed ducts.

C. Staples shall be sealed to maintain vapor barrier.

D. Neatly cut insulation at dampers, temperature control sensors, and controllers. Butter exposed edges with approved mastic coating.
E. Application - Type IV Insulation:

1. Insulation shall be cut slightly longer than perimeter of duct to insure full thickness at corners. All insulation shall be applied with edges tightly stitched with staples. Provide vapor barrier mastic sealer at seam. The insulation shall be additionally secured to the bottom of all square ducts eighteen (18) inches or wider by means of welded pins and speed clips. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor barrier facing shall be thoroughly sealed where the pins have pierced through with a tape of the same material by applying a vapor barrier adhesive to both surfaces as recommended by the manufacturer.

2. All hanger rods, support members, joints and penetrations of the vapor barrier shall be sealed with full thickness insulation and vapor barrier mastic sealer. All cuts or tears shall be sealed with strips of the aluminum foil tape and vapor barrier adhesive.

END OF SECTION 230700
SECTION 230900 – BUILDING AUTOMATION AND TEMPERATURE CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, General Requirements and all other Specification Sections apply to the work specified in this section.

1.2 SUMMARY

A. Section Includes:

1. Fully integrated building automation and temperature control system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified.

1.3 SCOPE

A. The Building Automation System (BAS) manufacturer shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified.

B. The new system shall be an extension of and connected to the existing MUSC Johnson Controls Metasys management system which is used for energy management. All setpoints and programs must be able to be modified and changed through the JCI user interface without additional hardware or gateways.

C. The BAS shall be a Web based system communicating over the building owners Local Area Network (LAN). 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. TCP/IP connections and addresses shall be provided by the owner for connection of supervisory panels to the USC network.

D. The primary desktop and laptop interface will be via a standard Web Browser such as Internet Explorer or Netscape. BAS contractor shall provide software license(s) for BAS WEB access for a minimum of twenty concurrent users.

E. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation or identification number and sequence of operation all bearing the name of the manufacturer. The installing manufacturer shall certify in writing, that the shop drawings have been prepared by the equipment manufacturer and that the equipment manufacturer has supervised their installation. In addition, the equipment manufacturer shall certify, in writing, that the shop drawings were prepared by their company and that all temperature control equipment was installed under their direct supervision.

F. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.

G. BAS manufacturer shall be responsible for all BAS and Temperature Control wiring for a complete and
1.4 INTERFACE REQUIREMENTS

A. The BAS contractor shall provide all necessary hardware and software to integrate the new control system with the existing USC campus BAS. Integration means the ability to monitor, override, change set points, and provide real-time bi-directional dynamic data exchange between the new control system and the existing BAS hardware and software.

B. The existing MUSC campus BAS is a Johnson Controls Metasys system. The BAS is comprised of multiple supervisory controllers, monitoring and communicating with various building control systems over the MUSC campus Ethernet LAN system. The new building control system will be connected to, and communicate with, the existing campus BAS server via the USC campus Ethernet LAN.

C. All new control points, monitoring points and software points shall be added to the existing MUSC BAS database and shall be available for monitoring and adjustment at any computer, with current copy of Microsoft Internet Explorer software (Release 6.0 or later), that is connected to the MUSC LAN.

D. All new building software and databases shall be archived on the hard drive at the MUSC BAS server. In the event that any building controller should lose its program that controller’s archived software program shall be downloaded across the BAS network from the BAS server to the respective building controller.

E. The BAS contractor will provide all necessary hardware, software, and labor to allow communication with any computer, with current copy of Microsoft Internet Explorer (Release 6.0 or later), that is connected to the MUSC LAN.

F. Integrity of the existing BAS shall be maintained during installation.

G. The building control system shall be compatible in every respect with existing Metasys BAS hardware and software. All new controllers shall be compatible with Metasys database and Metasys software development tools.

1.5 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
1.6 WORK BY OTHERS

A. Mechanical contractor installs all wells, valves, taps, dampers, flow stations, etc. furnished by BAS manufacturer.

B. Electrical Contractor provides:
   1. 120V power to all BAS and/or Temperature control panels. Where not shown on plans, locations shall be determined by the BAS contractor and coordinated with the Architect and electrical contractor.
   2. Wiring of all power feeds through all disconnect starters to electrical motor.

C. Products furnished but not installed under this section
   1. Control Valves
   2. Pressure and Temperature Sensor Wells and Sockets

D. The control manufacturer shall cooperate with the air and water balancing agency in the performance of their work as required or directed.

1.7 SUBMITTEDS

A. 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 Architect for Contract compliance.

B. 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.

C. The BAS Contractor shall correct any errors or omissions noted in the first review.

D. At a minimum, submit the following:
   1. BAS network architecture diagrams including all nodes and interconnections.
   2. Systems schematics, sequences and flow diagrams.
   3. Points schedule for each point in the BAS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
   4. Samples of Graphic Display screen types and associated menus.
   5. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
   6. 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.
   7. Room Schedule including a separate line for each VAV box and/or terminal unit indicating
8. Details of all BAS interfaces and connections to the work of other trades.
9. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.8 WARRANTY

A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year after beneficial use.
B. The adjustment, required testing, and repair of the system includes all computer equipment, transmission equipment and all sensors and control devices.
C. The on-line support services shall allow the local BAS subcontractor to dial out over telephone lines to monitor and control the facility's building automation system. This remote connection to the facility shall be within 2 hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekends and holidays.

1.9 IDENTIFICATION

A. Identify control wires and compressed air piping with a distinctive number on a nonconducting tag attached to each end or at junction points or by color coding of that wire or tube. Designate on control diagram the identifying color and/or number or other identifying designation used.
B. Identify all control equipment and devices, including panels, controllers, valves, and automatic dampers, etc., by a method approved by the Architect. Designations shall match those used on control diagrams and shop drawings.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN

A. Johnson Controls, Inc. (JCI).
B. System must extend and connect to the existing JCI network control systems installed in Medical University of South Carolina.

2.2 GENERAL DESCRIPTION

A. The Building Automation System (BAS) shall use an open architecture. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.
B. The Building Automation shall consist of the following:
   1. Standalone Network Automation Engine(s)
   2. Field Equipment Controller(s)
   3. Input/Output Module(s)
   4. Local Display Device(s)
5. Distributed User Interface(s)  
6. Network processing, data storage and communications equipment  
7. Other components required for a complete and working BAS

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. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

2.3 BAS ARCHITECTURE

A. Automation Network

1. The BAS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Utilize existing application and data server as required for systems operation.
2. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
3. Network Automation Engines (NAE) shall reside on the automation network.
4. The automation network will be compatible with other campus-wide networks. Where indicated, the automation network shall be connected to the campus network and share resources with it by way of standard networking devices and practices.

B. Control Network

1. Network Automation Engines shall provide supervisory control over the control network.
2. Control networks shall provide either “Peer-to-Peer,” Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network
4. Wireless communication between DDC controllers is acceptable. All sensors shall be wired.

C. Distributed Web Based User Interface

1. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
2. Alarms
   a. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
      1) Log date and time of alarm occurrence.
      2) Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
      3) Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
      4) Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user,
the alarm, the action taken on the alarm, and a time/date stamp.

5) Provide the capability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.

6) Any attribute of any object in the system may be designated to report an alarm.

b. The BAS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions

3. Reports and Summaries

a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:

1) All points in the BAS
2) All points in each BAS application
3) All points in a specific controller
4) All points in a user-defined group of points
5) All points currently in alarm
6) All points locked out
7) All BAS schedules
8) All user defined and adjustable variables, schedules, interlocks and the like.

b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.

c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.

d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.

e. Energy Essentials Software: Provide a focused set of reports that includes essential information required for effective management of energy resources. Required includes but shall not be limited to:

1) Energy Overview
2) Load Profile
3) Simple Energy Cost
4) Consumption
5) Equipment Runtime
6) Electrical Energy
7) Energy Production

f. Reports shall be selectable by date, time, area and device. Each report shall include a graphical color visual summary of essential energy information.

4. Schedules

a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:

1) Weekly schedules
2) Exception Schedules
3) Monthly calendars.

b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.

c. It shall be possible to define one or more exception schedules for each schedule including references to calendars

5. Dynamic Color Graphics

a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.

b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.

c. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.

6. Historical trending and data collection

a. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:

1) Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed:

   a) Defined time interval
   b) Upon a change of value

2) Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

b. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in either Microsoft Access or SQL database format.

7. Trend data viewing and analysis

a. Provide a trend viewing utility that shall have access to all database points.

b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.

c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends

d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.

e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.

f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.

g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.
2.4 NETWORK AUTOMATION ENGINES (NAE)

A. Network Automation Engine (NAE)

1. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.

2. Automation network – The NAE shall reside on the automation network and shall support a subnet of system controllers.

3. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.

4. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

5. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

6. Power Failure – In the event of the loss of normal power, the NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
   a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
   b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

2.5 DDC SYSTEM CONTROLLERS

A. Field Equipment Controller (FEC)

1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.

2. Controllers shall be factory programmed with 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.

3. The FEC shall be assembled in a plenum-rated housing with flammability rated to UL94-5VB.

4. The FEC shall include a removable base to allow pre-wiring without the controller.

5. The FEC shall accommodate the direct wiring of analog and binary I/O field points.

6. The FEC shall support the following types of inputs and outputs:
   a. Universal Inputs - shall be configured to monitor any of the following:
      1) Analog Input, Voltage Mode
      2) Analog Input, Current Mode
      3) Analog Input, Resistive Mode
      4) Binary Input, Dry Contact Maintained Mode
      5) Binary Input, Pulse Counter Mode
   b. Binary Inputs - shall be configured to monitor either of the following:
1) Dry Contact Maintained Mode
2) Pulse Counter Mode

c. Analog Outputs - shall be configured to output either of the following
   1) Analog Output, Voltage Mode
   2) Analog Output, current Mode

d. Binary Outputs - shall output the following:
   1) 24 VAC Triac

e. Configurable Outputs - shall be capable of the following:
   1) Analog Output, Voltage Mode
   2) Binary Output Mode

7. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
   a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet
   b. The FC Bus shall support communications between the FECs and the NAE.
   c. The FC Bus shall support a minimum of 100 IOMs and FEC in any combination.
   d. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the
      furthest connected device.

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

9. The FEC shall support, but not be limited to, the following:
   a. Terminal units
   b. Special programs as required for systems control.

2.6 FIELD DEVICES

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

B. Networked Thermostat (TEC)
   1. The Networked Thermostats shall be capable of controlling the following:
      a. A four pipe fan coil system with multi-speed fan control.
b. A two pipe fan coil with a single speed fan.
c. The Networked Thermostat shall support remote read/write and parameter adjustment from
   the web based User Interface able through a Network Automation Engine.

2. The Networked Thermostat shall include an intuitive User Interface providing plain text messages.
   a. Two line, 8 character backlit display
   b. LED indicators for Fan, Heat, and Cool status
   c. Five (5) User Interface Keys

      1) Mode
      2) Fan
      3) Override
      4) Degrees C/F
      5) Up/Down

3. The Networked Thermostats shall provide the flexibility to support the following inputs:
   a. Integral Indoor Air Temperature Sensor
   b. Duct Mount Air Temperature Sensor
   c. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator.
   d. Two configurable binary inputs

4. The Networked Thermostats shall provide the flexibility to support the following outputs:
   a. Three Speed Fan Control
   b. On/Off Control
   c. Floating Control
   d. Proportional (0 to 10V) Control

C. VAV Modular Assembly (VMA)

1. The VAV Modular Assembly shall provide both standalone and networked direct digital control of
   pressure-independent, variable air volume terminal units. It shall address both single and dual
   duct applications.
2. The VAV Modular Assembly shall communicate over the FC Bus using BACnet Standard
   protocol SSPC-135, Clause 9.
3. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and
   MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
4. The VAV Modular Assembly shall be a configurable digital controller with integral differential
   pressure transducer and damper actuator. All components shall be connected and mounted as a
   single assembly that can be removed as one piece.
5. The VAV Modular Assembly shall be assembled in a plenum-rated plastic housing with
   flammability rated to UL94-5VB.
6. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees
   in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
7. The controller shall determine airflow by dynamic pressure measurement using an integral dead-
   ended differential pressure transducer. The transducer shall be maintenance-free and shall not
   require air filters.
8. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate
   pressure transducer offset error due to ambient temperature / humidity effects.
9. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature
   control loops.
10. Each controller shall continuously, adaptively tune the control algorithms to improve control and
    controller reliability through reduced actuator duty cycle. In addition, this tuning reduces
commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

11. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.

12. Control set point changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of set point changes and to provide consistent operation in the event of communication failure.

13. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.

14. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.

15. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow set points.

16. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop’s sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. 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.

17. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:

   a. Unreliable space temperature sensor.
   b. Unreliable differential pressure sensor.
   c. Starved box.
   d. Actuator stall
   e. Insufficient cooling.
   f. Insufficient heating.

18. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.

19. The 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.

20. The 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.

21. Inputs:

   a. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:

      1) 0-10 VDC Sensors
      2) 1000ohm RTDs
      3) NTC Thermistors
b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”

c. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.

d. Provide side loop application for humidity control.

22. Outputs

a. Analog outputs shall provide the following control outputs:

1) 0-10 VDC

b. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.

c. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

23. Application Configuration

a. The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.

24. Sensor Support

a. The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.

b. The VMA shall support an LCD display room sensor.

c. The VMA shall also support standard room sensors as defined by analog input requirements.

d. The VMA shall support humidity sensors defined by the AI side loop.

D. Network Sensors (NS)

1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:

   a. Zone temperature
   b. Zone humidity
   c. Zone carbon dioxide
   d. Zone set point


3. The Network Sensors shall include the following items:

   a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Set point.
   b. An LED to indicate the status of the Override feature.
   c. A button to toggle the temperature display between Fahrenheit and Celsius.
   d. A button to initiate a timed override command

4. The NS shall be available with either screw terminals or phone jack.

5. The NS shall be available in either surface mount or wall mount styles.
2.7 INPUT DEVICES

A. General Requirements

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors

1. General Requirements:
   a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
   b. 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.
   c. 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:

2. Room Temperature Sensors
   a. Room sensors shall be constructed for either surface or wall box mounting.
   b. Room sensors shall have the following options when specified:
      1) Set point reset slide switch providing a +3 degree (adjustable) range.
      2) Individual heating/cooling set point slide switches.
      3) A momentary override request push button for activation of after-hours operation.

3. Thermo wells
   a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
   b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
   c. Thermo wells and sensors shall be mounted in a threadolet or 1/2” NFT saddle and allow easy access to the sensor for repair or replacement.
   d. Thermo wells shall be constructed of 316 stainless steel.

4. Duct Mount 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. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
   c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

5. Averaging Sensors
   a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
   b. For plenum applications, such as mixed air temperature measurements, 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.
c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

6. Acceptable Manufacturers: Johnson Controls, Setra.

C. Humidity Sensors

1. The sensor shall be a solid-state type, relative humidity sensor of the 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 Deg 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 enclosure with sealite fittings and stainless steel bushings.
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.

D. Carbon Dioxide Sensors

1. Duct Mounted
   a. Sensor shall be remote-mounted diffusion-aspirated, single-beam dual-wavelength sensor type with Infrared (IR) source, sample cell, tunable-interference filter, and IR detector.
   b. Sensing cell shall be provided with thirty (30) inch cable for duct mounting.
   c. Sensor shall produce linear analog 0-1 Volt DC, 4-20 MA, and binary adjustable switch point form C outputs.
   d. Range shall be 0-2000 parts per million with accuracy of three (3) percent.
   e. Sensor shall be mounted in weather tight enclosure with forty-one (41) degree Fahrenheit to 104 degree Fahrenheit operating temperature.
   f. Acceptable Manufacturers: Johnson Controls.

2. Wall Mounted
   a. Sensor shall be wall-mounted diffusion-aspirated, single-beam dual-wavelength sensor type with Infrared (IR) source, sample cell, tunable-interference filter, and IR detector.
   b. Sensing cell shall be provided with thirty (30) inch cable for duct mounting.
   c. Sensor shall produce linear analog 0-1 Volt DC, 4-20 MA, and binary adjustable switch point form C outputs.
   d. Range shall be 0-2000 parts per million with accuracy of three (3) percent.
   e. Sensor shall be mounted in weather tight enclosure with forty-one (41) degree Fahrenheit to 104 degree Fahrenheit operating temperature.
   f. Acceptable Manufacturers: Johnson Controls.

2.8 OUTPUT DEVICES

A. Actuators

1. General Requirements
a. Damper and valve actuators shall be electronic. Controls submittals shall indicate actuator fail position as normally open or closed.

2. Electronic Valve Actuators
   a. Electronic valve actuators shall be manufactured by the valve manufacturer.
   b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
   c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized based on valve manufacturer’s recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.
   d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
   e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.
   f. Acceptable manufacturers: Johnson Controls.

B. Control Relays
   1. Control Pilot Relays
      a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
      b. Mounting Bases shall be snap-mount.
      c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
      d. Contacts shall be rated for 10 amps at 120VAC.
      e. Relays shall have an integral indicator light and check button.
      f. Acceptable manufacturers: Johnson Controls, Lectro

C. Control Valves (Hot Water Systems)
   1. All automatic control valves shall be “pressure independent” type, fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.
   2. Hot water control valves shall be modulating ball type. Modulating water valves shall be sized per manufacturer’s recommendations for the given application. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.
   3. Ball valves shall be used for hot water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.
   4. Acceptable manufacturers: Erie, Johnson Controls, Danfoss, Delta Flow
PART 3 - EXECUTION

3.1  BAS 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.  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.

C.  Terminal Equipment:
   a.  Terminal Units (VAV, FCU etc.) shall have electric damper and valve actuation.
   b.  All Terminal Units shall be controlled with HVAC-DDC Controller.

3.2  INSTALLATION PRACTICES

A.  BAS Wiring
   1.  All conduit, wiring, accessories and wiring connections required for the installation of the Building Automation, as herein specified, shall be provided by the BAS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
   2.  All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.
   3.  The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS 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 so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
B. BAS 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.

C. Penetrations

1. Provide fire stopping for all penetrations used by dedicated BAS 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.

D. BAS 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.

E. BAS Panel Installation

1. The BAS 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 BAS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

F. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BAS in accessible local control panels wherever possible.

G. HVAC Input Devices – General

1. All Input devices shall be installed per the manufacturer recommendation.
2. Locate components of the BAS 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.
5. 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.

6. Space Sensors:
   a. Shall be coordinated with Architectural plans and mounted per ADA requirements.
   b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.

7. Do not cover or conceal sensors with insulation.

H. HVAC Output Devices

1. 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.
2. 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.
3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
4. Control Valves:
   a. 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.
   b. Install valves in piping with stems as vertical as possible but in no case less than forty-five (45) degrees from vertical. For soldered or welded connections, remove valve internals before installation.
   c. Wire electric valves in accordance with NFPA 70 with not less than two (2) feet of flexible liquidtight connector with watertight bushings at the valve actuator and conduit termination. Brace conduit to the building structure to prevent movement and damage.
5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Automation 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 manufacturer shall provide factory trained instructor to give full instruction to designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The manufacturer shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.

B. Provide training for Owner’s designated operating personnel. Training shall include:

1. Explanation of drawings, operations and maintenance manuals
2. Walk-through of the job to locate control components
3. Operator workstation and peripherals
4. DDC controller and ASC operation/function
5. Operator control functions including graphic generation and field panel programming
6. Explanation of adjustment, calibration and replacement procedures
7. Student binder with training modules

C. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Manufacturer. If such training is required by the Owner, it will be contracted at a later date.

3.4 COMMISSIONING

A. Fully commission all aspects of the Building Automation work.

B. Acceptance Check Sheet
   1. Prepare a check sheet that includes all points for all functions of the BAS as indicated on the point list included in this specification.
   2. Submit the check sheet to the Architect for approval
   3. The Architect will use the check sheet as the basis for acceptance with the BAS Contractor.

C. VAV box performance verification and documentation:
   1. The BAS 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 and submitted to the Architect for review. 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 BAS 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.

D. Promptly rectify all listed deficiencies and submit to the Architect that this has been done.

3.5 TEMPERATURE CONTROL

A. The sequences on the drawings describe the general intent of the control systems. Provide all devices, equipment, and wiring as required to perform the sequences described.

B. See plans for locations of all room thermostats, humidistats, carbon dioxide sensors, panels, dampers, valves, and equipment; where such devices are not indicated, however required by the sequences they shall be provided and located in the field by the Architect.

C. Division 26 shall furnish all detection devices (heat/smoke) as required by NFPA Standard 90A and the International Building and Mechanical Codes. The installation of detection devices and all control/power wiring for smoke detection devices and smoke dampers shall be provided under this section. Detection devices shall provide automatic shutdown of the HVAC systems in accordance with NFPA 90A.

D. All pumps and fans shall be provided with a current switches installed around the pump or fan. Sensors shall provide status for pump and fan operation.
E. Adjustable freezestats shall be provided at all preheat and heating coils and shall de-energize their respective air handling system when their setting of thirty-five (35) degrees Fahrenheit is reached. Freezestats for water coils shall be installed in coil leaving air stream.

F. All temperature, humidity, pressure, and time set points shall be fully adjustable from the BAS.

G. Where used to control both comfort heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5ºF within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum. Variable air volume (VAV) terminal units shall be programmed to operate at the minimum airflow setting without addition of reheat when the zone temperature is within the set deadband.

H. All two (2) position dampers shall be proven open by the use of end switches.

I. Refer to input/output summary schedule for additional control items not described in the sequences. Input/output summary are minimum requirements, provide all required points for complete operation of system.

J. All variable frequency drives for fan shall be soft started at minimum speed and increased to operating speed by the BAS.

K. Carbon dioxide (CO2) monitors shall be provided for each air handling system on this project to provide continuous monitoring of CO2 levels. Abnormal levels of CO2 shall be detected by the monitors and alarmed on the BAS.

END OF SECTION 230900
SECTION 233110 – AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and general provisions of the Contract, including General and Supplementary Conditions, General Requirements and all other Specification Sections apply to the work specified in this section.

1.2 SCOPE

A. Air devices, including registers, grilles and diffusers.

B. The requirements of Division 23, Section “Mechanical and Electrical General Provisions” shall apply to the work specified under this section.

PART 2 - PRODUCTS

2.1 AIR DEVICES

A. Provide air devices of the minimum sizes and quantities indicated and of the types specified. Contractor shall carefully study the drawings and the field conditions to ascertain the air device requirements as to suitability, location, air capacity, required accessories, border and finish. Devices shall be selected to provide draft-free air distribution over entire area served and sound rating shall not exceed Noise Criteria (NC) 25.

B. Border types shall be compatible with Architectural ceiling type for the room for which the air device is located. All devices shall have plaster frames when installed in plaster or drywall construction.

C. Margins shall be as indicated or directed to suit field conditions.

D. Provide Titus, Kreuger, Price, Metalaire or Tuttle & Bailey air devices in accordance with the schedule below and on the drawings.

E. Air Device Schedule:

<table>
<thead>
<tr>
<th>Device</th>
<th>Type</th>
<th>Finish</th>
<th>Basis of Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling Supply Diffuser</td>
<td>A</td>
<td>#26 white</td>
<td>Titus/TDCA</td>
</tr>
<tr>
<td>Return/Exhaust Grille</td>
<td>B</td>
<td>#26 white</td>
<td>Titus/PAR</td>
</tr>
</tbody>
</table>

1. Type A: Ceiling diffusers shall be Titus Model TDCA (steel) or prior approved equal for adjustable discharge pattern. These diffusers shall consist of an outer frame assembly of the sizes and mounting types shown on the plans and outlet schedule. A square or rectangular inlet shall be an integral part of the frame assembly and a transition piece shall be available to facilitate attachment of round duct. An inner core assembly consisting of fixed deflection louvers shall be available in one-, two-, three- or four-way horizontal discharge patterns. Diffuser shall include adjustable vanes to provide full vertical projection as well as horizontal projection. The inner core assembly must be removable in the field without tools for easy installation, cleaning or damper
adjusment.

a. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

b. Opposed blade volume damper shall not be provided. Throw Reducing Vanes (TRV) must be available to deflect a horizontal discharge airstream from each side of the TDC diffuser into diverging airstreams.

c. Molded insulation blanket shall be provided. The insulation shall be R-6, foil-backed, and provide an additional 1-inch gap around the neck to install insulated flex duct.

d. The manufacturer shall provide published performance data for the diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

2. Type B: Perforated ceiling return register shall be Titus model PAR (steel, flush face) or approved equal for return. Diffusers shall have a perforated face with 3/16-inch diameter holes on ¼-inch staggered centers and no less than 51 percent free area. Perforated face shall be steel. The backpan shall be one piece stamped heavy gauge steel of the sizes and mounting types shown on the plans and outlet schedule. The diffuser neck shall have 1 1/8-inch depth for easy duct connection.

a. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

b. Optional round volume damper shall not be provided.

c. The manufacturer shall provide published performance data for the square panel diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

F. Paint the ductwork behind registers with flat black enamel so that bright surface cannot be seen. Properly prime galvanized surface prior to painting.

PART 3 - EXECUTION

3.1 AIR DEVICES

A. Install air devices in accordance with the manufacturer's latest published installation instruction to insure against incorrect air pattern, drafts, and dirt smudging.

B. Construct, and install sheet metal duct or plenum connections to air devices in accordance with terminal manufacturer's recommendations.

C. Make modifications to the duct systems as required to accommodate actual sizes of air devices furnished, e.g., transformations and collar sizes without additional cost.

D. Make joints between each device and its components, connecting duct, or the mounting surface airtight, using gasket or its equivalent.
E. Align exposed butt edges of linear diffusers using slots and keys strips or with other concealed means.

END OF SECTION 233110
SECTION 233113 – METAL DUCTS

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. Single-wall rectangular ducts and fittings.
   2. Single-wall round and flat-oval ducts and fittings.
   4. Sealants and gaskets.
   5. Hangers and supports.

B. Related Sections:
   1. Section 230593 "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.
   2. Section 233116 "Nonmetal Ducts" for acid digestion exhaust ductwork.
   3. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS
A. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. INFORMATIONAL SUBMITTALS
1. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class,
applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.
2. Type: S.
3. Grade: NS.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

2.6 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.
2. Ductmate Industries, Inc.
3. Hilti Corp.
5. Loos & Co.; Cableware Division.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

C. Restraint Cables: ASTM A 603, galvanized or ASTM A 492, stainless-steel cables (matching duct construction) with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

D. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.


3.2 DUCT SEALING

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
4. Unconditioned Space, Exhaust Ducts: Seal Class B.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

F. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

2. Test the following systems:
   a. Ducts with a Pressure Class of 4-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

4. Test for leaks before applying external insulation.

5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

B. Supply Air Ducts:
   1. Ducts Connected to Terminal Units (downstream, from terminal unit to air device):
      a. Concealed: Single wall, round, oval or rectangular as shown.
      b. Pressure Class: Positive 2-inch wg.
      c. Minimum SMACNA Seal Class: B.
      d. SMACNA Leakage Class for Rectangular: 12.
      e. SMACNA Leakage Class for Round and Flat Oval: 6.
   2. Ducts Connected to Air-Handling Units (between air handling units and terminal units):
      a. Concealed: Single wall, round, oval or rectangular as shown.
      b. Pressure Class: Positive 4-inch wg.
      c. Minimum SMACNA Seal Class: A.
      d. SMACNA Leakage Class for Rectangular: 6.
      e. SMACNA Leakage Class for Round and Flat Oval: 3.

C. Indoor Exhaust Ducts:
1. Single wall, round, oval or rectangular as shown.
2. Pressure Class: Negative 2-inch wg.
3. Minimum SMACNA Seal Class: B.
4. SMACNA Leakage Class for Rectangular: 12.
5. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Intermediate Reinforcement:


E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Radius-to-Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.
SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

2. Fire dampers.
3. Flange connectors.
4. Duct-mounted access doors.
5. Flexible connectors.
6. Flexible ducts.
7. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

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

   a. Special fittings.
   c. Fire-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.
PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION


B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Air Balance Inc.; a division of Mestek, Inc.
      b. American Warming and Ventilating; a division of Mestek, Inc.
      c. McGill AirFlow LLC.
      d. Nailor Industries Inc.
      e. Potterff.
      f. Ruskin Company.
      g. Trox USA Inc.
      h. Vent Products Company, Inc.

   2. Comply with AMCA 500-D testing for damper rating.
   3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
   4. Suitable for horizontal or vertical applications.
   5. Frames:
      a. Hat shaped.
      b. 0.094-inch-thick, galvanized sheet steel.
      c. Mitered and welded corners.
      d. Flanges for attaching to walls and flangeless frames for installing in ducts.
6. **Blades:**
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized, roll-formed steel, 0.064 inch thick.

7. **Blade Axles:** 1/2-inch- diameter; galvanized steel hex-shaped.

8. **Bearings:**
   a. Molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. **Blade Seals:** Vinyl.

10. **Jamb Seals:** Cambered stainless steel.

11. **Tie Bars and Brackets:** Galvanized steel.

12. **Accessories:**
   a. Include locking device to hold single-blade dampers in a fixed position without vibration.

B. **Jackshaft:**

1. **Size:** 0.5-inch diameter.
2. **Material:** Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. **Length and Number of Mountings:** As required to connect linkage of each damper in multiple-damper assembly.

C. **Damper Hardware:**

2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 **FIRE DAMPERS**

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorff.
8. Prefco; Perfect Air Control, Inc.
10. Tamco; T. A. Morrison & Co., Inc.
B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL. Fire damper shall have Static Rating for HVAC systems that shut down automatically in a fire or smoke emergency or Dynamic Rating for HVAC systems that remain operational during a fire or smoke emergency.

C. Closing rating for dynamic dampers in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours. 3-hour dampers shall be installed where required by wall or floor rating.

E. Provide Type 304, stainless-steel dampers for installation in stainless steel ductwork and corrosive atmospheres.

F. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

G. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
   1. Minimum Thickness: 20 gauge thick, as indicated, and of length to suit application.
   2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

H. Mounting Orientation: Vertical or horizontal as indicated.

I. Blades: Roll-formed, interlocking, 24 gauge thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

J. Horizontal Dampers: Include blade lock and stainless-steel closure spring.


2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Ductmate Industries, Inc.
   2. Nexus PDQ; Division of Shilco Holdings Inc.

B. Description: Factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.6 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. American Warming and Ventilating; a division of Mestek, Inc.
   2. Cesco Products; a division of Mestek, Inc.
   3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
10. Ventfabrics, Inc.


1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.7 DUCT ACCESS PANEL ASSEMBLIES

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

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.

D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.
2.8 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ventfabs, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.


   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

2.9 FLEXIBLE DUCTS

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

1. Castco.
2. Flexmaster U.S.A., Inc
3. McGill AirFlow LLC.

B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

   1. Pressure Rating: 6-inch wg positive and 1.0-inch wg negative.
   3. Temperature Range: Minus 20 to plus 175 deg F.
   4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply and exhaust systems where branches extend from larger ducts. Dampers shall be installed at least two duct diameters from fittings and as far away as possible from outlets. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install fire dampers according to UL listing.

F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
3. Elsewhere as indicated.

G. Install access doors with swing against duct static pressure.

H. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.

I. Label access doors according to Section 230530 "Basic Materials and Methods" to indicate the purpose of access door.

J. Install flexible connectors to connect ducts to equipment.

K. For fans developing static pressures of 3-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

L. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible connectors.
Do not use flexible ducts to change directions.

M. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

N. Connect flexible ducts to metal ducts with draw bands or adhesive plus sheet metal screws and tape.

O. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300
SECTION 233600 – AIR TERMINAL UNITS

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. Shutoff, non-laboratory, single-duct air terminal units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.

1. Air terminal units.
2. Liners and adhesives.
3. Sealants and gaskets.

B. Shop Drawings: For air terminal units. 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. Wiring Diagrams: For power, signal, and control wiring.
3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

2.2 SYSTEM DESCRIPTION

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

2.3 SHUTOFF, SINGLE-DUCT SUPPLY AIR TERMINAL UNITS

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

1. Anemostat Products; a Mestek Company.
2. Carnes.
3. Envirotec
4. Johnson Controls, Inc
5. Krueger.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
9. Titus

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 22 gauge steel, single wall.

1. Casing Lining: Adhesive attached, 3/4-inch thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.

E. Attenuator Section: 0.034-inch steel sheet.
1. **Lining:** Adhesive attached, 3/4-inch-thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

2. **Airstream Surfaces:** Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

### F. Hydronic Coils:

1. Enclosed in minimum twenty (20) gauge galvanized steel casing, factory installed on the terminal discharge.

2. Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

3. Number of coil rows and circuits shall be selected to provide performance as scheduled on the drawings. Coil performance data shall be based on tests run in accordance with ARI Standard 410.

### G. Direct Digital Controls:

1. Factory installed controls furnished under Division 23, Section “Building Automation and Temperature Controls”.

2. The terminals shall be equipped with pressure independent controls which can be reset to modulate airflow between zero and the maximum cataloged cubic feet per minute. Maximum airflow limiters are not acceptable.

3. The direct digital controls shall be supplied by the control contractor and mounted by the terminal unit manufacturer. Control contractor shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware, and methods, as well as wiring and piping diagrams for each application identified by unit tag per the schedule in the drawings, to the terminal manufacturer.

4. Controls shall be compatible with pneumatic inlet velocity sensors supplied by the terminal manufacturer. The sensor shall be multi-point center averaging type, with a minimum of four measuring ports parallel to the take-off point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03 inch wg. at an inlet velocity of 500 fpm. The sensor must provide control signal accuracy of plus or minus five (5) percent with the same size inlet duct at any inlet condition.

5. Controls shall be field set by control contractor for the scheduled minimum and maximum flow rates. Flow measuring taps and flow curves will be supplied with each terminal for field balancing airflow. All pneumatic tubing shall be UL listed fire retardant (FR) type. Each terminal shall be equipped with labeling showing unit location, size, minimum and maximum cubic feet per minute setpoints, damper fail position, and thermostat action.

6. The terminal manufacturer shall provide a Class II 24 VAC transformer and disconnect switch. Actuator shall be direct connection shaft mount type without linkage. All controls shall be installed in approved NEMA type sheet metal enclosure by terminal manufacturer.

### 2.4 SHUTOFF, SINGLE-DUCT EXHAUST AIR TERMINAL UNITS

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

1. Anemostat Products; a Mestek Company.
2. Carnes.
3. Envirotec.
4. Johnson Controls, Inc
5. Krueger.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
9. Titus

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

1. Terminal unit shall be a unit specifically manufactured for exhaust airflow with rectangular inlet and outlets, and not a supply terminal unit installed backwards with relocated airflow sensors.

C. Casing: 22 gauge steel, single wall.

1. Casing Lining: Adhesive attached, 3/4-inch thick, fiber-free liner complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
2. Air Inlet: Rectangular S-slip and drive connections for duct attachment.
3. Air Outlet: Rectangular S-slip and drive connections for duct attachment.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.

E. Attenuator Section: 0.034-inch steel sheet.

1. Lining: Adhesive attached, 3/4-inch thick, nin-fibrous insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

F. Direct Digital Controls:

1. Factory installed controls furnished under Division 23, Section “Building Automation and Temperature Controls”.
2. The terminals shall be equipped with pressure independent controls which can be reset to modulate airflow between zero and the maximum cataloged cubic feet per minute. Maximum airflow limiters are not acceptable.
3. The direct digital controls shall be supplied by the control contractor and mounted by the terminal unit manufacturer. Control contractor shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware, and methods, as well as wiring and piping diagrams for each application identified by unit tag per the schedule in the drawings, to the terminal manufacturer.
4. Controls shall be compatible with pneumatic inlet velocity sensors supplied by the terminal manufacturer. The sensor shall be multi-point center averaging type, with a minimum of four measuring ports parallel to the take-off point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03 inch wg. at an inlet velocity of 500 fpm. The sensor must provide control signal accuracy of plus or minus five (5) percent with the same size inlet duct at any inlet condition.
5. Controls shall be field set by control contractor for the scheduled minimum and maximum flow
rates. Flow measuring taps and flow curves will be supplied with each terminal for field balancing airflow. All pneumatic tubing shall be UL listed fire retardant (FR) type. Each terminal shall be equipped with labeling showing unit location, size, minimum and maximum cubic feet per minute setpoints, damper fail position, and thermostat action.

6. The terminal manufacturer shall provide a Class II 24 VAC transformer and disconnect switch. Actuator shall be direct connection shaft mount type without linkage. All controls shall be installed in approved NEMA type sheet metal enclosure by terminal manufacturer.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Steel Cables: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.6 SEISMIC-RESTRAINT DEVICES

A. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

B. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; with an automatic-locking and clamping device or double-cable clips.

C. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

D. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb.
C. Install units such that access panels, volume regulators and damper motors are readily accessible for maintenance and adjustment.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on air terminal units that are suspended with vibration isolators.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

F. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for
applications exposed to weather.

3.4 CONNECTIONS
A. Install piping adjacent to air terminal unit to allow service and maintenance.
B. Hot-Water Piping: Connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
C. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."
D. A straight section of unrestricted duct at least 2 diameters long should be installed at the inlet.

3.5 IDENTIFICATION
A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 FIELD QUALITY CONTROL
A. Perform tests and inspections.
B. Tests and Inspections:
   1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
   2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
C. Air terminal unit will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.7 STARTUP SERVICE
A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
   3. Verify that controls and control enclosure are accessible.
   4. Verify that control connections are complete.
   5. Verify that nameplate and identification tag are visible.
   6. Verify that controls respond to inputs as specified.
3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units..

END OF SECTION 233600
SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
   1. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. 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.
   3. Pressure Plates: Stainless steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. 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. 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.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. 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.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section ”Penetration Firestopping.”

END OF SECTION 260500
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. Connectors, splices, and terminations rated 600 V and less.
      3. Sleeves and sleeve seals for cables.
   B. Related Sections include the following:
      1. Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding and bonding.
      2. Division 26 Section "Identification for Electrical Systems" for identification requirements.

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. Source Limitations: Obtain all wire and cable of a particular type through one source from a single qualified manufacturer.
   B. 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.
C. 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.

D. 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.

E. 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:

2. General Cable Corporation.
5. Belden Wire and Cable Co.
6. Okonite Co.
7. Pirelli Cable Corp.
8. Rome Cable Corp.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THW and THHN-THWN.

2.2 CONNECTORS AND SPLICES

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

2. O-Z/Gedney; EGS Electrical Group LLC.
3. 3M; Electrical Products Division.
4. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch 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."

2.4 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: Stainless steel. 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.

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 THHN-THWN, 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. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

G. Flexible Metal Conduit with THHN-THWN conductors shall be used for fixture whips, minimum 3/4” conduit size.

H. MC Cable **SHALL NOT** be used on this project.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

J. Class 1 Control Circuits: Type THHN-THWN, in raceway.

K. 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."

3.4 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.

3.5 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 rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
   2. For sleeve 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 wall surfaces.

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 cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

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 cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual cables 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. Size sleeves 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 cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
3.7 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."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.

C. 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.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519
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.

1.3 DEFINITIONS
   A. EMT: Electrical metallic tubing.
   B. IMC: Intermediate metal conduit.
   C. RMC: Rigid metal conduit.

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.

1.5 SUBMITTALS
   A. Product Data: For the following:
      1. Steel slotted support systems.
   B. Shop Drawings: Signed and sealed by a qualified professional engineer. 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. 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. **Powder-Actuated Fasteners**: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, 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) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. **Mechanical-Expansion Anchors**: Insert-wedge-type, stainless 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:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. **Concrete Inserts**: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. **Clamps for Attachment to Steel Structural Elements**: MSS SP-58, type suitable for attached structural element.

5. **Through Bolts**: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. **Toggle Bolts**: All-steel springhead type.

7. **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 required by 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 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 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
5. 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 meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

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.

END OF SECTION 260529
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.
B. Related Sections include the following:
   1. Division 26 Section "Wiring Devices" for devices installed in boxes, metallic multi-outlet assemblies, and for floor-box service fittings.
   2. Division 7 Section “Through-Penetration Firestop Systems: for fire-stopping materials and installation at penetrations through walls, ceilings and other fire-rated elements.

1.3 DEFINITION
A. EMT: Electrical metallic tubing.
B. EPDM: Ethylene-propylene-diene terpolymer rubber.
C. FMC: Flexible metal conduit.
D. IMC: Intermediate metal conduit.
E. LFMC: Liquidtight flexible metal conduit.
F. Lighting fixture whips: NEC maximum length of flexible conduit run from junction box in fixed raceways to lighting fixtures, to allow movement of the lighting fixture for initial installation and maintenance.
G. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS
A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
B. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."

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. 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. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Manhattan/CDT/Cole-Flex.
7. O-Z Gedney; a unit of General Signal.
8. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.

G. 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. Fittings for EMT: Steel or die-cast, compression type.
2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

2.2 SURFACE RACEWAYS

A. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Butler Manufacturing Company; Walker Division.
   b. Enduro Systems, Inc.; Composite Products Division.
   c. Hubbell Incorporated; Wiring Device-Kellem's Division.
   d. Lamson & Sessions; Carlon Electrical Products.
   e. Panduit Corp.
   g. Wiremold Company (The); Electrical Sales Division.

2.3 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.
7. RACO; a Hubbell Company.
10. Spring City Electrical Manufacturing Company.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Metal Floor Boxes: Cast metal, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron 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.
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.

2.4 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."

2.5 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: Stainless steel. 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.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Lighting fixture whips: flexible metal conduit, ¼” conduit size minimum (MC Cable is not allowed).
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

B. Minimum Raceway Size: 3/4-inch trade size.

C. 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.

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. 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.
   I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
   J. 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.
   K. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic, rigid and flexible, as follows:
      1. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
2. 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.

L. 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.

M. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed 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.

N. Lighting Fixture Whips: Lighting fixture whips shall only be installed between raceway junction box and a single light fixture. Do not daisy chain lighting fixtures together. Do not use ceiling wire supports to support flexible metal conduit or fixture whips. Independent wires that are not used to support can be used to support raceways provided they are painted or tagged per National Electrical Code requirements.

O. 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.

P. Set metal floor boxes level and 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 or unless seismic criteria require different clearance.

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 Penetraions: 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
SECTION 260536 - CABLE TRAYS 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. Ladder cable trays.
2. Basket cable trays.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

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. Include 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 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. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
   2. Component Importance Factor: 1.0.

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 Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles on 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 TRAYS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Cable Management Solutions, Inc.
   2. Cablofil Inc.
   3. Cooper B-Line, Inc.
   5. MonoSystems
   6. Niedax
   7. ADC, TE Connectivity
B. Description:

1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
2. Rung Spacing: 12 inches o.c.
3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
5. No portion of the rungs shall protrude below the bottom plane of side rails.
6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
8. Straight Section Lengths: 12 feet except where shorter lengths are required to facilitate tray assembly.
9. Width: 6 inches and 12 inches unless otherwise indicated on Drawings.
10. Fitting Minimum Radius: 12 inches.
11. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

2.4 BASKET CABLE TRAYS

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

1. Cable Management Solutions, Inc.
2. Cablofil Inc.
3. Cooper B-Line, Inc.
5. MonoSystems
6. Niedax
7. ADC, TE Connectivity

B. Description:

1. Configuration: 12 inches wide and 4 inches deep. Wire mesh spacing shall not exceed 2 by 4 inches.
2. Fitting Minimum Radius: 12 inches.
3. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

2.5 MATERIALS AND FINISHES

A. Aluminum:

1. Materials: Alloy 6063-T6 according to ANSI H35.1/H35.1M for extruded components, and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H35.1/H35.1M for fabricated parts.
3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.6 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.7 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."

2.8 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 260529 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."

H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
L. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

M. 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.

N. Make changes in direction and elevation using manufacturer's recommended fittings.

O. Make cable tray connections using manufacturer's recommended fittings.

P. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

Q. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

R. Install cable trays with enough workspace to permit access for installing cables.

S. 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 Section 260526 "Grounding and Bonding for Electrical Systems."

B. 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.

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.

3.4 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
B. Connect raceways 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 with the assistance of a factory-authorized service representative:

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 260536
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. This Section includes the following:
   1. Identification for raceway and metal-clad cable.
   2. Identification for conductors and communication and control cable.
   3. Warning labels and signs.
   4. Instruction signs.
   5. Equipment identification labels.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

   B. Comply with NFPA 70.

1.5 COORDINATION

   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 RACEWAY 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. Color for Printed Legend:

1. Power Circuits: Black letters on an orange field.
2. Legend: Indicate system or service and voltage, if applicable.

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.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE 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. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Aluminum Wraparound Marker Labels: Cut from 0.014-inch thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.

E. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 WARNING LABELS AND SIGNS

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

E. 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."

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. 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.

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. 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 ultraviolet-resistant seal for label.


2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

2. Tensile Strength: 50 lb, minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
B. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.

C. 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 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange self-adhesive vinyl label or self-adhesive vinyl tape applied in bands.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl label or self-adhesive vinyl tape applied in bands:

1. Fire Alarm System: Red
2. Fire-Suppression Supervisory and Control System: Red and Yellow
3. Combined Fire Alarm and Security System: Red and Blue
4. Security System: Blue and Yellow
5. Mechanical and Electrical Supervisory System: Green and Blue
6. Telecommunication System: Green and Yellow
7. Control Wiring: Green and Red
8. Emergency Power System: Green

C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in pull and junction boxes, and handholes use color-coding conductor tape or write-on tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape or write-on tags. Identify each ungrounded conductor according to source and circuit number.


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.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. 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.

2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

H. Instruction Signs:

1. Operating Instructions: 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.

I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and 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, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where 2 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.

2. Equipment to Be Labeled:
   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchboards.
   d. Emergency system boxes and enclosures.
   e. Disconnect switches.
   f. Enclosed circuit breakers.
   g. Motor starters/ VFC’s.
   h. Push-button stations.
   i. Contactors.
   j. Remote-controlled switches, dimmer modules, and control devices.
   k. Fire-alarm control panel and annunciators.
   l. Lighting Control Panels

3.2 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 non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color 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. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.

3. Colors for 480/277-V Circuits:
   b. Phase B: Orange.
   c. Phase C: Yellow.

4. 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.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

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 exceeds 16 inches overall.

J. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION 260553
SECTION 260590 - SELECTIVE ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of Division 01, Division 02, and this Division.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.
D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

F. Repair adjacent construction and finishes damaged during demolition and extension work. T-bar ceiling tiles damaged under normal construction conditions or having voids where junction boxes were removed shall be replaced by the Contractor.

G. Maintain access to existing electrical installations which remain active.

H. Extend existing installations using materials and methods as specified.

I. Where materials or equipment are to be turned over to Owner or reused and installed by the Contractor, it shall be the Contractor’s responsibility to maintain condition of materials and equipment equal to the existing condition of the equipment before the work began. Repair or replace damaged materials or equipment at no additional cost to the Owner.

3.4 EXISTING PANELBOARDS

A. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.

B. Provide new updated directories where more than three circuits have been modified or rewired.

3.5 CLEANING AND REPAIR

A. A. Clean and repair existing materials and equipment which remain or are to be reused.

3.6 INSTALLATION

A. A. Install relocated materials and equipment under the provisions of Division 01.

END OF SECTION 260590
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.

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 occupancy and light-level sensors.
   1. Floor plan showing sensor locations and coverage. Indicate mounting height/location for optimal coverage.
   2. Interconnection diagrams showing field-installed wiring.

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. Hubbell Lighting.
3. Lutron.
4. Watt Stopper.

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

2.2 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. 14 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 WIRING INSTALLATION
   A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 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.

3.3 FIELD QUALITY CONTROL
   A. Perform the following field tests and inspections and prepare test reports:
      1. After installing 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.

3.4 DEMONSTRATION
   A. 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
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.

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 ACTION 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.

1.4 INFORMATIONAL SUBMITTALS
A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
B. Qualification Data: For testing agency.
C. Source quality-control test reports.
D. Field quality-control test reports.
1.5 CLOSEOUT SUBMITTALS

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

1.6 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."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.8 COORDINATION

A. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2. General Electric Company.
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. Provide transformers that are constructed to withstand seismic forces specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.
   1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.
   1. Finish Color: ANSI 49 gray.

F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

H. Energy Efficiency for Transformers Rated 15 kVA and Larger:
   1. Complying with NEMA TP 1, Class 1 efficiency levels.
   2. Tested according to NEMA TP 2.

I. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
   1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
   2. Include special terminal for grounding the shield.
   3. Shield Effectiveness:
      a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
      b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
      c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.
J. Wall Brackets: Manufacturer's standard brackets.

K. Fungus Proofing: Permanent fungicidal treatment for coil and core.

L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

M. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91.

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 Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

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 Section 260526 "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.

1. Brace wall-mounting transformers as specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. 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.

D. Tests and Inspections:

   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. 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. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
   3. 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.

G. 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. 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
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

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. 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."

1.5 ACTION 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. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
   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. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "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.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. 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.

1.9 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.

1.10 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.

1.11 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 (minus 5 deg C) to plus 104 deg F (plus 40 deg C).


B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

   1. Ambient temperatures within limits specified.

   2. Altitude not exceeding 6600 feet (2000 m).

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 Architect no fewer than two days in advance of proposed interruption of electric service.

   2. Do not proceed with interruption of electric service without Architect's written permission.

   3. Comply with NFPA 70E.
1.12 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 with concrete.

1.13 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.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

6. 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.
   c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
   3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
   4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
   5. Split Bus: Vertical buses divided into individual vertical sections.

E. Conductor Connectors: Suitable for use with conductor material and sizes.
   2. Main and Neutral Lugs: Mechanical type.
   3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
   4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
   5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
   6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
   7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

F. 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.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.


2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.
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 (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only.


F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

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.

F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable 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\(t\) response.
4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

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. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.

2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to panelboards.

5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

F. 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.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

K. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "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 Section 260553 "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 Section 260553 "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.

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. 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
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. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Snap switches and wall-box dimmers.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
D. RFI: Radio-frequency interference.
E. TVSS: Transient voltage surge suppressor.
F. UTP: Unshielded twisted pair.

1.4 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.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For wiring devices to include in all manufacturers’ packing label warnings and instruction manuals that include labeling conditions.

1.5 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.

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; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. 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; 5351 (single), 5352 (duplex).
   b. Hubbell; HBL5351 (single), CR5352 (duplex).
   c. Leviton; 5891 (single), 5352 (duplex).
   d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; GF20.
   b. Pass & Seymour; 2084.

2.4 COMBINATION USB CHARGER TR RECEPTACLES

A. Standard AC Duplex tamper resistant receptacle with two USB charging ports rated at 2.1 A, UL listed to UL 498 and UL 1310.

1. Basis-of-Design product: Subject to compliance with requirements, provide Cooper; TR7745 (15 A), TR7746 (20 A) or comparable product by one of the following:
a. Hubbell; USB15X2 (15A only).
b. Pass and Seymour; TR5362USB.

B. Device shall have an LED indicator to notify a user that a device is connected to the USB port for charging.

C. Device shall have auto grounding feature.

D. Device shall have triple wipe blade contacts (Hot-Neutral) and double wipe ground contacts to insure long-term blade retention.

E. Device shall have two AC outlets and two USB charging ports (3.1 A @ 5 V DC).

SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
   b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
   c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
   d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.6 OCCUPANCY SENSORS

A. See Division 26 Section, “Lighting Control Devices.”

2.7 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic
3. Material for Unfinished Spaces: Galvanized steel
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
5. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum with lockable cover.

2.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices and plates Connected to Normal Power System: Submit color chart to Architect for selection.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. 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 the 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.

C. 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. Pig-tailing existing conductors is permitted provided the outlet box is large enough.

D. 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. **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.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. **When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.**
8. Tighten unused terminal screws on the device.
9. **When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.**

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down.
F. 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.

G. 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.

H. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Use durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED 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 not acceptable.
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. The 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.

END OF SECTION 262726
SECTION 265100 - 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. This Section includes the following:
   1. Interior lighting fixtures, lamps, and ballasts.
   2. Exit signs.
   3. Lighting fixture supports.

B. Related Sections include the following:
   1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including occupancy sensors.
   2. Division 26 Section "Wiring Devices" for manual wall-box dimmers.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of lighting fixture including dimensions.
   2. Ballast.
   4. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
   5. Lamps: Provide data on each type of lamp used and listed mercury content.
B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.


C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. 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.

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. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

   1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

   2. Warranty Period for Emergency Fluorescent Ballast Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

   1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
C. Special Warranty for T8 and T5 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Lighting Fixture Schedule where titles below are column or row headings that 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 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

G. 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.

H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

I. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
   b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

1. Sound Rating: A
2. Transient Voltage Protection: IEEE C62.41, Category A or better.
3. Operating Frequency: 20 kHz or higher.
4. Lamp Current Crest Factor: 1.7 or less.
5. BF: 0.85 or higher.
6. Power Factor: 0.95 or higher.
7. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
8. Ballasts for single lamp fixtures shall be electronic high-frequency ballasts to comply with ASHRAE requirements.

B. Electronic Programmed-Start Ballasts for T5 Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.

C. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

D. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.

E. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

F. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
a. High-Level Operation: 100 percent of rated lamp lumens.
b. Low-Level Operation: 30 percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed instant-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
   1. Lamp end-of-life detection and shutdown circuit.
   2. Automatic lamp starting after lamp replacement.
   3. Sound Rating: A.
   4. Total Harmonic Distortion Rating: Less than 20 percent.
   5. Transient Voltage Protection: IEEE C62.41, Category A or better.
   6. Operating Frequency: 20 kHz or higher.
   7. Lamp Current Crest Factor: 1.7 or less.
   8. BF: 0.95 or higher, unless otherwise indicated.
   9. Power Factor: 0.95 or higher.
   10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
   1. Dimming Range: 100 to 5 percent of rated lamp lumens.
   2. Ballast Input Watts: Can be reduced to 20 percent of normal.
   3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.5 BALLASTS FOR HID LAMPS

A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
   1. Lamp end-of-life detection and shutdown circuit.
   2. Sound Rating: A.
   3. Total Harmonic Distortion Rating: Less than 15 percent.
   4. Transient Voltage Protection: IEEE C62.41, Category A or better.
   5. Lamp Current Crest Factor: 1.5 or less.
   6. Power Factor: .90 or higher.
   7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
   8. Protection: Class P thermal cutout.
   9. Retain subparagraph and associated subparagraphs below for bi-level ballasts.
2.6 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.7 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

B. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours, unless otherwise indicated.

C. T8 rapid-star low-mercury lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.

D. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches, 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3000 K, and average rated life of 20,000 hours, unless otherwise indicated.

E. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100K, and average rated life of 20,000 hours, unless otherwise indicated.

F. Compact Fluorescent Lamps: 4-Pin, low-mercury, CRI 80 (minimum), color temperature 3500K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.8 HID LAMPS

A. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.

B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000K.
2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "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 fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.


E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.

2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

4. Install at least two independent support rods or wires from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.


3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to provide required light intensities.

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation.

END OF SECTION 265100
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 1 Specification Sections, apply to this Section.

1.2 CODES AND STANDARDS:
A. ANSI/ASME A11 Safety Code for elevators and escalators
B. Factory Mutual (FM), FM AG Approval Guide
C. International Building Code (IBC) 2012
D. NFPA Standards 101, 72, 1221 and 90A, latest edition
E. National Electrical Code, latest edition
F. Local Building Code
G. Requirements of local Fire Departments
H. UL Publication

1.3 SUMMARY
A. This Section includes an extension of the existing fire alarm systems with detectors, signal equipment, controls, devices and wiring.

1.4 DEFINITIONS
A. FACP: Fire alarm control panel.
B. LED: Light-emitting diode.
C. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.5 SYSTEM DESCRIPTION
A. General: The existing fire alarm system is an automatic system.

1.6 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings:

1. Wiring Diagrams: Detail wiring and differentiate between manufacturer-installed and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified.
2. Floor Plans: Indicate final outlet locations and routings of raceway connections.
3. Device Address List: Coordinate with final system programming.
4. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.

C. Operating Instructions: For mounting at the FACP.

D. Product Certificates: Signed by manufacturers of system components certifying that products furnished comply with requirements.

E. Installer Certificates: Signed by manufacturer certifying that installers comply with requirements.

F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Comply with NFPA 72.

G. Maintenance Data: For fire alarm systems to include in maintenance manuals specified in Division 1. Comply with NFPA 72.

H. Submissions to Authorities Having Jurisdiction: In addition to distribution requirements for Submittals specified in Division 1 Section "Submittals," make an identical submission to authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

I. Certificate of Completion: Comply with NFPA 72.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the FACP manufacturer for both installation and maintenance of units required for this Project. The manufacturer’s representative must have a satisfactory record of performance, together with providing adequate service with sufficient stock of replacement parts, as demonstrated by at least ten (10) systems of the same type, similar size and duty, within fifty (50) miles of the job site, which have been performing for not less than two (2) years.

1. All connections to the FACP, plus the system’s programming, shall be done only by the manufacturer, or by an authorized distributor that stocks a full compliment of spare parts for the system. The technicians who do this are required to be trained and individually certified by the manufacturer, for the FACU model/series being installed. This training and certification must have occurred within the most recent 24 months. Copies of the certifications must be part of the contractor’s submittal to the engineer, prior to installation. The submittal cannot be approved without this information.

B. Manufacturer Qualifications: A firm experienced in manufacturing systems similar to those indicated for this Project and with a record of successful in-service performance.
C. Source Limitations: Obtain fire alarm system components through one source from a single manufacturer.

D. Compliance with Local Requirements: Comply with applicable building code, local ordinances and regulations, and requirements of authorities having jurisdiction.

E. Comply with NFPA 72.

F. The manufacturer, or authorized distributor, must maintain software version (VER) records on the system installed. The system software shall be upgraded free of any charge if a new VER is released during the warranty period. For new VER to correct operating problems, free upgrade shall apply during the entire life of the system.

1.8 SEQUENCING AND SCHEDULING

A. Existing Fire Alarm Equipment: Maintain 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 the new fire alarm system devices, remove existing disconnected fire alarm equipment and restore damaged surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Match existing fire alarm system – Edwards EST 4 fire alarm control panel.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Control of System: By the existing FACP. All functions/performance of the existing system shall remain the same.

B. System Reset: All zones are manually resettable from the FACP after initiating devices are restored to normal.

C. Signaling Line Circuits (SLC): Circuits shall be Class B, Style 6 with no T taps made. Each SLC must have a minimum of 20% spare addresses.

D. Notification Appliance Circuits (NAC): Circuits shall be Class B, Style Y. The load connected to each circuit shall not exceed 80% of rated module output and the coverage of each shall not exceed three floors.

E. Basic Alarm Performance Requirements: Unless otherwise indicated, operation of a manual station, automatic alarm operation of a smoke or flame or heat detector, or operation of a sprinkler flow device initiates the following:
1. Notification-appliance operation.
2. Identification at the FACP and the remote annunciator of the device originating the alarm.
3. Transmission of an alarm signal to the remote alarm receiving station.
4. Unlocking of electric door locks in designated egress paths.
5. Release of fire and smoke doors held open by magnetic door holders.
6. Shutdown of fans and other air-handling equipment serving zone when alarm was initiated.
7. Closing of smoke dampers in air ducts of system serving zone where alarm was initiated.
8. Recording of the event in the system memory.

F. Removal of an alarm-initiating device or a notification appliance initiates the following:

1. A "trouble" signal indication at the FACP and the annunciator for the device or zone involved.
2. Recording of the event by the system printer.
3. Transmission of trouble signal to remote alarm receiving station.

2.3 SMOKE DETECTORS

A. General: Include the following features:

1. Operating Voltage: 24-V dc, nominal.
2. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
3. Plug-in Arrangement: Detector and associated electronic components are mounted in a module that connects in a tamper-resistant manner to a fixed base with a twist-locking plug connection. Terminals in the fixed base accept building wiring.
4. Integral Visual-Indicating Light: LED type. Indicates detector has operated.
5. Sensitivity: Can be tested and adjusted in-place after installation. Set to normal/medium unless directed otherwise by the engineer/owner.
6. Built-in Locking Device: Spot-type smoke detectors shall have a built-in locking device to secure the head to the base, for tamper resistance. For detectors mounted within 12 feet of the floor, activate this lock after the system has been inspected and given final acceptance.
7. Automatic Drift Compensation: When programming the system, activate the automatic drift compensation fixture.

2.4 NOTIFICATION APPLIANCES

A. Description: Equip for mounting as indicated and have screw terminals for system connections.


B. Voice/Tone Notification Appliances:

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.
5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971 with clear or nominal white polycarbonate lens. Mount lens on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
1. All visual outputs shall be synchronized.
2. Provide candela output as shown on the drawings. Exception: Devices in corridors less than 20' wide and in rooms smaller than 20’ x 20’ may be rated 15 candela. Where conflicts between specifications and drawings occur, the most stringent shall apply.

2.5 REMOTE DEVICE LOCATION-INDICATING LIGHTS AND IDENTIFICATION PLATES

A. Description: LED indicating light near each smoke detector that may not be readily visible, and each sprinkler water-flow switch and valve-tamper switch. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.6 EMERGENCY POWER SUPPLY

A. General: Upgrade as needed to accommodate new devices on the existing system.

2.7 WIRE


1. Low-Voltage Circuits: No. 14 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

B. Power-Limited Circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.

1. Color code as follows: Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACP. Acceptable cables include Atlas 228-18-1-1STP, Belden YQ28541, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG14), or equal wire having capacitance of 30 pf/ft. maximum between conductors. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.
2. Unshielded Cable, otherwise equal to the above, is permitted to be used where the manufacturer’s installation instructions unequivocally require, or state a preference for, the use of unshielded cable for all systems.
3. In underground conduit, use Type TC or PLTC cable (PE insulated) to avoid problems from moisture.

2.8 POWER SUPPLIES

A. Notification Appliance Circuit booster (“ADA”) power supplies must be individually monitored for integrity and are not permitted to be located above a ceiling, or in non-conditioned space. Any 24vdc power circuits serving addressable control relays must also be monitored for integrity. Provide a smoke detector within 15 feet of the power supply.
2.9 ISOLATION MODULES

A. To minimize the impact of a wiring fault (short), isolation modules or (if the ceiling height is < 10 feet) isolator base type initiating devices shall be provided as follows:

1. After each 25 devices and control points on any addressable circuit.
2. For each addressable circuit that extends outside the building walls.
3. In or immediately adjacent to the FACP, at each end of the addressable loop. These two isolators must be in the same room as the FACP and within 15 feet.
4. For loops covering more than one floor, install isolator at terminal cabinet on each floor (with additional isolator(s) on any floor with over 25 addresses).

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Smoke Detectors: Comply with manufacturer's written instructions. Each smoke detector shall be installed in accordance with NFPA 72. Do not locate detectors next to supply or return grilles. Do not exceed maximum spacing as indicated in NFPA 72.

B. Audible Alarm-Indicating Devices: Install 80” AFF to device bottom.

C. Visible Alarm-Indicating Devices: Install 80” AFF to device bottom.

D. Device Location-Indicating Lights: Locate in public space near the device they monitor.

E. Detector Identification: Identification of individual detectors is required. Assign each a unique number as follows, in sequence starting at the FACP: (Addressable Loop#--Device#) Put on the as-built plans, and also permanently mount on each detector’s base so that it’s readable standing on the floor below without having to remove the smoke detector. Exception: for detectors with housings (i.e., air duct, projected beam, air sampling, flame), apply the identification to a suitable location on exterior of their housing.

3.2 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceway according to Division 16 Section "Raceways and Boxes." Conceal raceway except in unfinished spaces and as indicated.

B. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the manufacturer. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

C. Cable Taps: Use numbered terminal strips in junction, pull and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

D. Conduit Sealing: All conduits that penetrate walls from conditioned space to non-conditioned space shall have internal sealing (duct-seal) to prevent condensation from infiltrating humid air.
E. Splices: There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. “Wire nuts” and crimp splices will NOT be permitted. Permanent wire markers shall be used to identify all connections at the FACP and other control equipment, at power supplies, and in terminal cabinets.

F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signal from other floors or zones.

G. Terminal Cabinets: In multistory buildings, all circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

H. Junction Boxes: All junction boxes shall be painted red prior to pulling the wire. Those installed in finished areas are permitted to be painted outside to match the finish color.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Basic Electrical Materials and Methods."

3.4 GROUNDING

A. Ground equipment and conductor and cable shields. For audio circuits, minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

3.5 Inspection, Test, Adjustment, and Report:

A. The Contractor and an authorized factory-trained and certified representative of the manufacturer shall perform a complete system test by operating all system devices. The inspection, tests, and adjustments shall include the following:

1. Visual inspection of all equipment.
2. Verification of fire and trouble alarm signals at all receiving locations, including audible and visual alarms. Owner's personnel may be required for this verification. All functions shall be verified including elevator capture HVAC shutdown, pressurization fans, smoke doors, etc.
3. Any defects detected during general tests and complete system tests shall be repaired as quickly as possible, and the tests re-conducted.
4. The NFPA 72 fire alarm system “Inspection and Testing” form and the Fire Alarm System “Certificate of Completion” form included with these specifications shall be completed and presented to the Engineer prior to the Engineer’s acceptance test.
5. The engineer shall then be informed by written notification that the system is complete per plans and specifications that the 100’s system test was completed and is ready for the Engineer’s acceptance test.

3.6 The Contractor shall notify the Engineer two (2) weeks in advance to schedule the Engineer’s acceptance test of the completed system.
3.7 Guarantee:

A. All wiring, etc., shall be in strict accordance with the local Electrical Code requirements and shall have the written approval of all public authorities having jurisdiction. The Contractor shall guarantee all equipment and wiring free from inherent mechanical and electrical defects for a period of two (2) years from date of installation. The final connection between the equipment and wiring system and all programming shall be made under the direct supervision of a qualified technical representative of the manufacturer. All products of combustion detectors shall have sensitivities set by Factory Trained Technician, and results submitted to the Architect.
PART 4 - SYSTEM FORMS

4.1 INSPECTION AND TESTING FORM

A. This form shall be completed by the system contractor as required by these specifications.

FIRE ALARM SYSTEM
Inspection and Testing Form

DATE: ____________________
TIME: ____________________

FIRE ALARM SERVICE ORGANIZATION

PROPERTY NAME (USER)

NAME: ____________________
ADDRESS: ____________________
REPRESENTATIVE: ______________
LICENSE NO.: _______________
TELEPHONE: ____________________

FIRE ALARM SERVICE ORGANIZATION

PROPERTY NAME (USER)

NAME: ____________________
ADDRESS: ____________________
REPRESENTATIVE: ______________
LICENSE NO.: _______________
TELEPHONE: ____________________

MONITORY ENTITY

APPROVING AGENCY

CONTACT: ____________________
TELEPHONE: ____________________

MONITORY ENTITY

APPROVING AGENCY

CONTACT: ____________________
TELEPHONE: ____________________

MONITORING ACCOUNT REF. NO.: ___________

TYPE TRANSMISSION

SERVICE

[ ] - McCulloh [ ] - Weekly
[ ] - Multiplex [ ] - Monthly
[ ] - Digital [ ] - Quarterly
[ ] - Reverse Priority [ ] - Semi-Annually
[ ] - RF [ ] - Annually
[ ] - Other (Specify) [ ] - Other (Specify)

____________________________________________________________________

____________________________________________________________________
PANEL MANUFACTURE: ___________________________ MODEL NO.: ________________
CIRCUIT STYLES: ______________________________
NO. OF CIRCUITS: ______________________________
SOFTWARE REV.: ______________________________
LAST DATE SYSTEM HAD ANY SERVICE PERFORMED: __________________________
LAST DATE THAT ANY SOFTWARE OR CONFIGURATION WAS REVISED: __________

ALARM INITIATING DEVICES AND CIRCUIT INFORMATION

QTY OF CIRCUIT STYLE
_______ _______ MANUAL STATIONS
_______ _______ HEAT DETECTORS
_______ _______ OTHER:
(SPECIFY) ________________________________________________

ALARM INDICATING APPLIANCES AND CIRCUIT INFORMATION

QTY OF CIRCUIT STYLE
_______ _______ HORNS
_______ _______ STROBES
_______ _______ OTHER:
(SPECIFY) ________________________________________________

NO. OF ALARM INDICATING CIRCUITS: __________________________

ARE CIRCUITS SUPERVISED? [ ] YES   [ ] NO

SUPERVISING SIGNAL INITIATING DEVICES AND CIRCUIT INFORMATION

SIGNALING LINE CIRCUITS
Quantity and style (See NFPA 72, Table 3-6.1) of signaling line circuits connected to system:

Quantity____________________ Style(s)____________________
Quantity____________________ Style(s)____________________

SYSTEM POWER SUPPLIES

a. Primary (Main): Nominal Voltage ___________, Amps____________
   Overcurrent Protection: Type_____________, Amps____________
   Location (Panel Number): ________________________________
   Disconnecting Means Location: ________________________________

b. Secondary (Standby):
   Storage Battery: Amp-Hr. Rating____________
   Calculated capacity to operate system, in hours: _______24 _______60 _________
   _______ Engine-driven generator dedicated to fire alarm system:
   Location of fuel storage: ________________________________

TYPE BATTERY

[ ] Dry Cell
[ ] Nickel Cadmium
[ ] Sealed Lead-Acid
[ ] Lead-Acid
[ ] Other (Specify) ________________________________

C. Emergency or standby system used as a backup to primary power supply, instead of using a secondary power supply:

___________ Emergency system described in NFPA 70, Article 700
___________ Legally required standby described in NFPA 70, Article 701
___________ Optional standby system described in NFPA 70, Article 702, which also meets the performance requirements of Article 700 or 701.

PRIOR TO ANY TESTING

NOTIFICATIONS ARE MADE: YES NO WHO TIME
| MONITORING ENTITY | [ ] | [ ] | [ ] | [ ] |
| BUILDING OCCUPANTS | [ ] | [ ] | [ ] | [ ] |
| BUILDING MANAGEMENT | [ ] | [ ] | [ ] | [ ] |
| OTHER (SPECIFY) | [ ] | [ ] | [ ] | [ ] |
| AHJ (NOTIFIED) OF ANY IMPAIRMENTS | [ ] | [ ] | [ ] | [ ] |

**SYSTEM TESTS AND INSPECTIONS**

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**SECONDARY POWER**

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<tbody>
<tr>
<td>BATTERY CONDITION</td>
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<tr>
<td>LOAD VOLTAGE</td>
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<tr>
<td>DISCHARGE TEST</td>
<td>[ ]</td>
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<tr>
<td>CHARGER TEST</td>
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<tr>
<td>SPECIFIC GRAVITY</td>
<td>[ ]</td>
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<tr>
<td>TRANSIENT SUPPRESSORS</td>
<td>[ ]</td>
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<tr>
<td>REMOTE ANNUNCIATORS</td>
<td>[ ]</td>
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<tr>
<td>NOTIFICATION APPLIANCES</td>
<td>[ ]</td>
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<tr>
<td>AUDIBLE</td>
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</tr>
<tr>
<td>VISUAL</td>
<td>[ ]</td>
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</table>

**INITIATING AND SUPERVISORY DEVICE TESTS AND INSPECTIONS**

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>VISUAL</th>
<th>FUNCTIONAL</th>
<th>FACTORY MEAS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOC. &amp; S/N</td>
<td>TYPE</td>
<td>CHECK</td>
<td>TEST</td>
</tr>
<tr>
<td>FAIL</td>
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<td></td>
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<tr>
<td>LOC. &amp; S/N</td>
<td>DEVICE TYPE</td>
<td>VISUAL CHECK</td>
<td>FUNCTIONAL TEST</td>
</tr>
<tr>
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</tbody>
</table>

**COMMENTS:**

_________________________________________________________________________________
___________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
## Visual Communications Equipment

<table>
<thead>
<tr>
<th></th>
<th>Visual</th>
<th>Functional</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHONE SET</td>
<td>[ ]</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>PHONE JACKS</td>
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<td></td>
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<tr>
<td>OFF-HOOK INDICATOR</td>
<td>[ ]</td>
<td>[ ]</td>
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</tr>
<tr>
<td>CALL IN SIGNAL</td>
<td>[ ]</td>
<td>[ ]</td>
<td></td>
</tr>
<tr>
<td>SYSTEM PERFORMANCE</td>
<td>[ ]</td>
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</tr>
</tbody>
</table>

### Notifications that Testing is Complete:

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
<th>WHO</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUILDING MANAGEMENT</td>
<td></td>
<td>[ ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MONITORING AGENCY</td>
<td></td>
<td>[ ]</td>
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<tr>
<td>BUILDING OCCUPANTS</td>
<td></td>
<td>[ ]</td>
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<tr>
<td>OTHER (SPECIFY)</td>
<td></td>
<td>[ ]</td>
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</tbody>
</table>

### The Following Did Not Operate Correctly:

- ____________________________________________________
- ____________________________________________________
- ____________________________________________________
- ____________________________________________________

### System Restored to Normal Operation:

DATE: ___________  TIME: ___________

THIS TESTING WAS PERFORMED IN ACCORDANCE WITH APPLICABLE NFPA STANDARDS.

### Name of Licensed or NICET Certified Inspector:

NICET CERTIFICATION NUMBER: ________________________________

DATE: ________________  TIME: ___________

SIGNATURE: ________________________________
4.2 CERTIFICATE OF COMPLETION FORM

A. This form shall be completed by the system contractor as required by these specifications.

FIRE ALARM SYSTEM

Certificate of Completion

Name of Protected Property: ________________________________________________________________

Address: ____________________________________________________________________________

Rep. of Protected Prop. (name/phone): ____________________________________________________

Authority Having Jurisdiction: __________________________________________________________

Address/Phone Number: __________________________________________________________________

1. Type(s) of System or Service:

____ NFPA 72, Chapter 3 - Local
   If alarm is transmitted to location(s) off premise, list where received:
   ________________________________________________________________________________

____ NFPA 72, Chapter 3 - Emergency Voice/Alarm Service
   Quantity of voice/alarm channels: ________ Single: ________ Multiple: ________
   Quantity of speakers installed: ________
   Quantity of speaker zones: ________
   Quantity of telephones or telephone jacks included in system: ________

____ NFPA 72, Chapter 4 - Auxiliary
   Indicate type of connection:
   Local energy, __________ Shunt, __________ Parallel telephone

   Location and telephone number for receipt of signals:
   ________________________________________________________________________________

____ NFPA 72, Chapter 4 - Remote Station

   Supervisory: ______________________________________________________________________

____ NFPA 72, Chapter 4 - Proprietary
   If alarms are retransmitted to public fire service communications center or others, indicate location
   and telephone number of the organization receiving alarm:
   ________________________________________________________________________________
Indicate how alarm is retransmitted:

___________________________________________________________

NFPA 72, Chapter 4 - Central Station
The Prime Contractor:

___________________________________________________________

Central Station Location:

___________________________________________________________

Means of transmission of signals from the protected premise to the central station:

_____McCulloh  _____Multiplex  _____One-Way Radio
_____Digital Alarm Communicator  _____Two-Way Radio  _____Others

Means of transmission of alarms to the public fire service communications center:
1. ___________________________________________________________
2. ___________________________________________________________

System Location: ___________________________________________________________

Organization Name/Phone  __________________________________________________

Representative Name/Phone _________________________________________________

Installer ___________________ Supplier ____________________________

Service Organization ______________________________________________________

Location of Record (As-Built) Drawings:

________________________________________________________________________

Location of Owners Manuals:

________________________________________________________________________

Location of Test Reports:

________________________________________________________________________

A contract, dated _________________________, for test and inspection in accordance with NFPA standard(s) No.(s)____________, dated ______________, is in effect.

2. Certification of System Installation
(Fill out after installation is complete and wiring checked for opens, shorts, ground faults, and improper branching, but prior to conducting operational acceptance tests.)

This system has been installed in accordance with the NFPA standards as listed below, was inspected by ____________________________ on ____________________, includes the devices listed below and has been in service since __________.

_____NFPA 72, Chapters 1 3 4 5 6 7 (circle all that apply)
_____NFPA 70, National Electrical Code, Article 760
_____Manufacturer’s Instructions
_____Other (specify): ______________________________________

Signed: __________________________ Date: ______________
Organization: __________________________ NICET Certification Number: ______________

3. Certification of System Operation

All operational features and functions of this system were tested by ____________________________ on ____________________ and found to be operating properly in accordance with the requirements of:

_____NFPA 72, Chapters 1 3 4 5 6 7 (circle all that apply)
_____NFPA 70, National Electrical Code, Article 760
_____Manufacturer’s Instructions
_____Other (specify): ______________________________________

Signed: __________________________ Date: ______________
Organization: __________________________
NICET Certification Number: ______________

4. Alarm Initiating Devices and Circuits (Use blanks to indicate quantity of devices.)

MANUAL
a) _____ Manual Stations _____ Non-coded,
b) Activating _____ Transmitters _____ Coded
b) _____ Combination Manual Fire Alarm and Guard’s Tour Coded Stations

AUTOMATIC
Coverage: Complete: _______ Partial: _______
a) _____ Smoke Detectors _____ Ion _____ Photo
b) _____ Heat Detectors _____ FT _____ RR _____ FT/RR _____ RC
c) _____ Other (list): _____________________________
5. Alarm Notification Appliances and Circuits:

   Quantity of indicating appliance circuits connected to the system: _________________

   Types and quantities of alarm indicating appliances installed:
   a) _____ Bells   _____ Inch   _____ Speakers
   b) _____ Horns
   c) _____ Chimes
   d) _____ Other: _________________
   e) _____ Visual Signals   Type: _________________ _____ with audible
          _____ w/o audible
   f) _____ Local Annunciator

6. Signal Line Circuits:

   Quantity and Style (See NFPA 72, Table 3-6.1) of signaling line circuits connected to system:
   Quantity: ______________ Style: ______________

7. System Power Supplies

   a) Primary (Main):   Nominal Voltage: ______________
          Current Rating: ______________
          Overcurrent Protection: Type: ______________
          Current Rating: ______________
          Location: __________________________________________

8. Comments:

   __________________________________________(signed) for Central
   Station or Alarm Service Co.(title) (date)

   Frequency of routine tests and inspections, if other than in accordance with the referenced NFPA standard(s):
   __________________________________________
   __________________________________________
System deviations from the referenced NFPA standard(s) are:

__________________________________________________________________

__________________________________________________________________

__________________________________________________________________

(signed) for Central Station or Alarm Service Co.  (title) (date)

Upon completion of the system(s) satisfactory test(s) witnessed (if required by the authority having jurisdiction):

__________________________________________________________________

(signed)  (title)  (date)

( Representative of the authority having jurisdiction )

END OF SECTION 283111