



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

**MULTI-STEP BIDDING PROCESS
FOR
CONTRACTORS**

**Request For Solicitation For
Construction Services**

Stage II – General Contractors Bidders List FY09

January 7, 2009

DATC COSMETOLOGY EXPANSION AREA REMODEL

DAVIS ATC

KAYSVILLE, UTAH

DFCM Project No. 08084220

**Scheer & Scheer Inc.
776 N East Capitol Blvd
Salt Lake City, Utah 84103**

TABLE OF CONTENTS

	Page #
Title Sheet	1
Table of Contents	2
Invitation to Bid	3
Stage II – Multi-Step Bidding Process	5
Stage II - Project Schedule	9
Bid Form	10
Bid Bond	12
Instructions and Subcontractors List Form	13
Contractor's Agreement	16
Performance Bond	21
Payment Bond	22
Certificate of Substantial Completion	23
General Contractor Performance Rating Form	

Current copies of the following documents are hereby made part of these contract documents by reference. These documents are available on the DFCM web site at <http://dfcm.utah.gov> or are available upon request from DFCM:

DFCM Supplemental General Conditions dated July 15, 2008
DFCM General Conditions dated May 25, 2005
DFCM Application and Certificate for Payment dated May 25, 2005

Technical Specifications:
Drawings:

The Agreement and General Conditions dated May 25, 2005 have been updated from versions that were formally adopted and in use prior to this date. The changes made to the General Conditions are identified in a document entitled Revisions to General Conditions that is available on DFCM's web site at <http://dfcm.utah.gov>

INVITATION TO BID

ONLY FIRMS PRE-QUALIFIED DURING STAGE I OF THE RFS ARE ALLOWED TO BID ON THIS PROJECT

The State of Utah - Division of Facilities Construction and Management (DFCM) is requesting bids for the construction of the following project:

Project Name: DATC Cosmetology Expansion Area Remodel – Davis ATC – Kaysville, Utah
DFCM Project No: 08084220

Project Description: Remodel existing Cosmetology area. Includes demo, new storefront glass and mechanical and electrical. The project will be bid with a base bid and two additive alternates.

Construction Cost Estimate: \$210,000

Company	Contact	Fax
Arnell-West, Inc.	Mr. Jason Arnell	(801) 975-9967
Ascent Construction	Mr. Brad L. Knowlton	(801) 299-0663
Bailey Construction Co., Inc.	Mr. Tracy Bailey	(435) 245-6413
Benstog Construction, Corp.	Mr. Patrick Benstog	(801) 399-1335
Big-D Construction	Mr. Ryan Carter	(801) 415-6900
Bradley Construction, LLC.	Mr. Brad Piggott	(801) 298-6308
Broderick and Henderson Const	Mr. Gary Broderick	(801) 225-4697
Bud Mahas Construction	Mr. Steve Mahas	(801) 531-0314
CECI	Mr. Brian E. Bagnell	(801) 484-4040
Chad Husband Construction, Inc.	Mr. Richard Marshall	(801) 886-1784
CSM Construction, Inc.	Mr. Dan Noorda	(801) 280-2813
Darrell Anderson Construction	Mr. James Anderson	(435) 752-7606
Entelen Design-Build, LLC	Mr. Steven R. Burt, AIA	(801) 542-8093
Garff Construction	Mr. Phil Henricksen	(801) 972-1928
Hidden Peak Electric Co., Inc.	Mr. Dereke Lee	(801) 262-5689
Hughes General Contractors	Mr. Dan Pratt	(801) 295-0530
JC Construction	Mr. John Cecala	(801) 262-7966
Keller Construction	Mr. S. Daniel Hill	(801) 972-1063
Layton Construction Company, Inc.	Mr. Steve Bowers	(801) 568-1490
McCullough Engineering	Mr. Jim McCullough	(801) 466-4989
Menlove Construction	Mr. Mike Menlove	(801) 282-6887
MW Construction, Inc.	Mr. Bill Shuldverg	(435) 245-4660
Onyx Construction	Mr. Mike Phillips	(801) 878-8922
Rueckert Construction Co.	Mr. Ken M. Rueckert	(801) 253-1774
Spindler Construction Corporation	Mr. Gary R. Stevens	(435) 753-0728
Velocity Construction, Inc.	Mr. J. Scott Wilson	(435) 586-4968
Veritas, Inc.	Mr. Dan A. Parkinson	(801) 572-5899
Wade Payne Construction, Inc.	Mr. Wade Payne	(801) 226-7772

The bid documents will be available on **Wednesday, January 7, 2009** in electronic format only on CDs from DFCM at 4110 State Office Building, Salt Lake City, Utah 84114, telephone (801)538-3018 and on the DFCM web page at <http://dfcm.utah.gov>. For questions regarding this project, please contact **Darrell Hunting**, Project Manager, DFCM, at **(801) 244-7647**. No others are to be contacted regarding this project.

A **MANDATORY** pre-bid meeting and site visit will be held at **2:00 PM** on **Tuesday, January 13, 2009** in **room 1011** at DATC – 550 East 300 South Kaysville, UT. 84037. All pre-qualified prime contractors wishing to bid on this project must attend this meeting.

Bids must be submitted by **3:30 PM** on **Wednesday, January 21, 2009** to DFCM, 4110 State Office Building, Salt Lake City, Utah 84114. Bids will be opened and read aloud in the DFCM Conference Room, 4110 State Office Building, Salt Lake City, Utah. Note: Bids must be received at 4110 State Office Building by the specified time. The contractor shall comply with and require all of its subcontractors to comply with the license laws as required by the State of Utah.

A bid bond in the amount of five percent (5%) of the bid amount, made payable to the Division of Facilities Construction and Management on DFCM's bid bond form, shall accompany the bid.

The Division of Facilities Construction & Management reserves the right to reject any or all bids or to waive any formality or technicality in any bid in the interest of the State.

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT
JOANNA REESE, CONTRACT COORDINATOR
4110 State Office Bldg., Salt Lake City, Utah 84114

STAGE II - MULTI-STEP BIDDING PROCESS

ONLY FIRMS PRE-QUALIFIED DURING STAGE I OF THE RFS ARE ALLOWED TO BID ON THIS PROJECT

1. Invitational Bid Procedures

The following is an overview of the invitational bid process. More detailed information is contained throughout the document. Contractors are responsible for reading and complying with all information contained in this document.

Notification: DFCM will notify each registered pre-qualified firm (via fax or e-mail) when a project is ready for Construction Services and invite them to bid on the project.

Description of Work: A description of work or plans/specifications will be given to each contractor. If required, the plans and specifications will be available on the DFCM web page at <http://dfcm.utah.gov> and on CDs from DFCM, at 4110 State Office Building, Salt Lake City, Utah 84114.

Schedule: The Stage II Schedule shows critical dates including the mandatory pre-bid site meeting (if required), the question and answer period, the bid submittal deadline, the subcontractor list submittal deadline, etc. Contractors are responsible for meeting all deadlines shown on the schedule.

Mandatory Pre-Bid Site Meeting: If a firm fails to attend a pre-bid site meeting labeled “Mandatory” they will not be allowed to bid on the project. At the mandatory meeting, contractors may have an opportunity to inspect the site, receive additional instructions and ask questions about project. The schedule contains information on the date, time, and place of the mandatory pre-bid site meeting.

Written Questions: All questions must be in writing and directed to DFCM’s project manager assigned to this project. No others are to be contacted regarding this project. The schedule contains information on the deadline for submitting questions.

Addendum: All clarifications from DFCM will be in writing and issued as an addendum to the RFS. Addenda will be posted on DFCM’s web site at <http://dfcm.utah.gov>. Contractors are responsible for obtaining information contained in each addendum from the web site. Addenda issued prior to the submittal deadline shall become part of the bidding process and must be acknowledged on the bid form. Failure to acknowledge addenda may result in disqualification from bidding.

Submitting Bids: Bids must be submitted to DFCM 4110 State Office Building, Salt Lake City, Utah 84114 by the deadline indicated on the schedule. Bids submitted after the deadline will not be accepted. Bids will be opened at DFCM on the date, time, and place indicated on the schedule.

Subcontractors List: The firm selected for the project must submit a list of all subcontractors by the deadline indicated on the schedule contained in this document.

Pre-qualified List of Contractors: Contractors shall remain on DFCM’s list of pre-qualified contractors provided: (a) they maintain a performance rating of 3.5 or greater on each project, (b) they are not suspended for failure to comply with requirements of their contract, (c) the firm has not undergone a significant reorganization involving the loss of key personnel (site superintendents, project managers, owners, etc.) to a degree such that the firm no longer meets the pre-qualification requirements outlined in Stage I, (d) the financial viability of the firm has not significantly changed, and (e) the firm is not otherwise disqualified by DFCM. Note: If a contractor fails to comply with items (a) through (e) above,

they may be removed from DFCM's list of pre-qualified contractors following an evaluation by a review committee. Contractors will be given the opportunity to address the review committee before a decision is made. Pre-qualified contractors are ONLY authorized to bid on projects within the discipline that they were originally pre-qualified under.

2. Drawings and Specifications and Interpretations

Drawings, specifications and other contract documents may be obtained as stated in the Invitation to Bid. If any firm is in doubt as to the meaning or interpretation of any part of the drawings, specifications, scope of work or contract documents, they shall submit, in writing, a request for interpretation to the authorized DFCM representative by the deadline identified in the schedule. Answers to questions and interpretations will be made via addenda issued by DFCM. Neither DFCM or the designer shall be responsible for incorrect information obtained by contractors from sources other than the official drawings/specifications and addenda issued by DFCM.

3. Product Approvals

Where reference is made to one or more proprietary products in the contract documents, but restrictive descriptive materials of one or more manufacturer(s) is referred to in the contract documents, the products of other manufacturers will be accepted, provided they equal or exceed the standards set forth in the drawings and specifications and are compatible with the intent and purpose of the design, subject to the written approval of the Designer. Such written approval must occur prior to the deadline established for the last scheduled addendum to be issued. The Designer's written approval will be included as part of the addendum issued by DFCM. If the descriptive material is not restrictive, the products of other manufacturers specified will be accepted without prior approval provided they are compatible with the intent and purpose of the design as determined by the Designer.

4. Addenda

All clarifications from DFCM will be in writing and issued as an addendum to the RFS. Addenda will be posted on DFCM's web site at <http://dfcm.utah.gov>. Contractors are responsible for obtaining information contained in each addendum from the web site. Addenda issued prior to the submittal deadline shall become part of the bidding process and must be acknowledged on the bid form. Failure to acknowledge addenda shall result in disqualification from bidding. DFCM shall not be responsible for incorrect information obtained by contractors from sources other than official addenda issued by DFCM.

5. Financial Responsibility of Contractors, Subcontractors and Sub-subcontractors

Contractors shall respond promptly to any inquiry in writing by DFCM to any concern of financial responsibility of the Contractor, Subcontractor or Sub-subcontractor. Failure to respond may result in suspension from DFCM's list of pre-qualified contractors.

6. Licensure

The Contractor shall comply with and require all of its Subcontractors to comply with the license laws as required by the State of Utah.

7. Permits

In concurrence with the requirements for permitting in the general conditions, it is the responsibility of the contractor to obtain the fugitive dust plan requirements from the Utah Division of Air Quality and the SWPPP requirements from the Utah Department of Environmental Quality and submit the completed forms and pay any permit fee that may be required for this specific project. Failure to obtain the required permit may result in work stoppage and/or fines from the regulating authority that will be the sole responsibility of the contractor. Any delay to the project as a result of any such failure to obtain the permit or noncompliance with the permit shall not be eligible for any extension in the Contract Time.

8. Time is of the Essence

Time is of the essence in regard to all the requirements of the contract documents.

9. Bids

Before submitting a bid, each bidder shall carefully examine the contract documents; shall visit the site of the work; shall fully inform themselves as to all existing conditions and limitations; and shall include in the bid the cost of all items required by the contract documents including those added via addenda. If the bidder observes that portions of the contract documents are at variance with applicable laws, building codes, rules, regulations or contain obvious erroneous or uncoordinated information, the bidder shall promptly notify the DFCM Project Manager prior to the bidding deadline. Changes necessary to correct these issues will be made via addenda issued by DFCM.

The bid, bearing original signatures, must be typed or handwritten in ink on the Bid Form provided in the procurement documents and submitted in a sealed envelope at the location specified by the Invitation to Bid prior to the published deadline for the submission of bids.

Bid bond security, in the amount of five percent (5%) of the bid, made payable to the Division of Facilities Construction and Management, shall accompany bid. **THE BID BOND MUST BE ON THE BID BOND FORM PROVIDED IN THE PROCUREMENT DOCUMENTS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID.**

If the bid bond security is submitted on a form other than DFCM's required bid bond form, and the bid security meets all other legal requirements, the bidder will be allowed to provide an acceptable bid bond by the close of business on the next business day following notification by DFCM of submission of a defective bid bond security. **A cashier's check cannot be used as a substitute for a bid bond.**

10. Listing of Subcontractors

Listing of Subcontractors shall be as summarized in the "Instructions and Subcontractor's List Form", included as part of the contract documents. The subcontractors list shall be delivered to DFCM or faxed to DFCM at (801) 538-3677 within 24 hours of the bid opening. Requirements for listing additional subcontractors will be listed in the contract documents.

DFCM retains the right to audit or take other steps necessary to confirm compliance with requirements for the listing and changing of subcontractors. Any contractor who is found to not be in compliance with these requirements may be suspended from DFCM's list of pre-qualified contractors.

11. Contract and Bond

The Contractor's Agreement will be in the form provided in this document. The duration of the contract shall be for the time indicated by the project completion deadline shown on the schedule. The successful bidder, simultaneously with the execution of the Contractor's Agreement, will be required to furnish a performance bond and a payment bond, both bearing original signatures, upon the forms provided in the procurement documents.

The performance and payment bonds shall be for an amount equal to one hundred percent (100%) of the Contract Sum and secured from a company that meets the requirements specified in the requisite forms. Any bonding requirements for Subcontractors will be specified in the Supplementary General Conditions.

12. Award of Contract

The Contract will be awarded as soon as possible to the lowest, responsive and responsible bidder, based on the lowest combination of base bid and acceptable prioritized alternates, provided the bid is reasonable, is in the interests of DFCM to accept and after applying the Utah Preference Laws in U.C.A. Title 63, Chapter 56. DFCM reserves the right to waive any technicalities or formalities in any bid or in the bidding. Alternates will be accepted on a prioritized basis with Alternate 1 being highest priority, Alternate 2 having second priority, etc. Alternates will be selected in prioritized order up to the construction cost estimate.

13. Right to Reject Bids

DFCM reserves the right to reject any or all Bids.

14. Withdrawal of Bids

Bids may be withdrawn on written request received from bidders within 24 hours after the bid opening if the contractor has made an error in preparing the bid.

15. DFCM Contractor Performance Rating

As a contractor completes each project, DFCM will evaluate project performance based on the enclosed "DFCM Contractor Performance Rating" form. The ratings issued on this project may affect the firm's "pre-qualified" status and their ability to obtain future work with DFCM.



Stage II PROJECT SCHEDULE

PROJECT NAME: DATC Cosmetology Expansion Area Remodel – Davis ATC – Kaysville, Utah DFCM PROJECT #: 08084220				
Event	Day	Date	Time	Place
Stage II Bidding Documents Available	Wednesday	January 7, 2009	10:00 AM	DFCM 4110 State Office Building SLC, UT and the DFCM web site*
Mandatory Pre-bid Site Meeting	Tuesday	January 13, 2009	2:00 PM	DATC – 550 East 300 South Kaysville, UT. 84037 Room # 1011
Deadline for Submitting Questions	Thursday	January 15, 2009	1:00 PM	<i>Darrell Hunting</i> – DFCM E-mail – dhunting@utah.gov Fax (801)-538-3267
Addendum Deadline (exception for bid delays)	Tuesday	January 20, 2009	2:00 PM	DFCM web site*
Prime Contractors Turn in Bid and Bid Bond	Wednesday	January 21, 2009	3:30 PM	DFCM 4110 State Office Building SLC, UT
Subcontractors List Due	Thursday	January 22, 2009	3:30 PM	DFCM 4110 State Office Building SLC, UT Fax 801-538-3677
Substantial Completion Date	Tuesday	March 31, 2009	4:00 PM	On Site

* NOTE: DFCM's web site address is <http://dfcm.utah.gov>



Division of Facilities Construction and Management

BID FORM

NAME OF BIDDER _____ DATE _____

To the Division of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

The undersigned, responsive to the "Invitation to Bid" and in accordance with the Request for Bids for the **DATC Cosmetology Expansion Area Remodel – Davis ATC – Kayville, Utah - DFCM Project No. 08084220** and having examined the Contract Documents and the site of the proposed Work and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: _____

For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of:

Base Bid:
_____ DOLLARS (\$ _____)
(In case of discrepancy, written amount shall govern)

Additive Alternate No. 1 (See Drawing A02 Alt 1 line)
_____ DOLLARS (\$ _____)
(In case of discrepancy, written amount shall govern)

Additive Alternate No. 2 (See Drawing A02 Alt 2 line)
_____ DOLLARS (\$ _____)
(In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete by March 31, 2009, should I/we be the successful bidder, and agree to pay liquidated damages in the amount of **\$300.00** per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor’s Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of _____

The undersigned Contractor's License Number for Utah is _____.

Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract. The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable 100% Performance and Payment bonds are not delivered within time set forth.

Type of Organization: _____
(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

Respectfully submitted,

Name of Bidder

ADDRESS:

Authorized Signature

BID BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed, (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the STATE OF UTAH, hereinafter referred to as the "Obligee," in the amount of \$ _____ (5% of the accompanying bid), being the sum of this Bond to which payment the Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the Principal has submitted to Obligee the accompanying bid incorporated by reference herein, dated as shown, to enter into a contract in writing for the _____ Project.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that if the said principal does not execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the principal, then the sum of the amount stated above will be forfeited to the State of Utah as liquidated damages and not as a penalty; if the said principal shall execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the Principal, then this obligation shall be null and void. It is expressly understood and agreed that the liability of the Surety for any and all defaults of the Principal hereunder shall be the full penal sum of this Bond. The Surety, for value received, hereby stipulates and agrees that obligations of the Surety under this Bond shall be for a term of sixty (60) days from actual date of the bid opening.

PROVIDED, HOWEVER, that this Bond is executed pursuant to provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their several seals on the date indicated below, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

DATED this _____ day of _____, 20_____ .

Principal's name and address (if other than a corporation):

By: _____

Title: _____

Principal's name and address (if a corporation):

By: _____

Title: _____

(Affix Corporate Seal)

Surety's name and address:

By: _____

Attorney-in-Fact (Affix Corporate Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this ____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.
My Commission Expires: _____
Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

**Division of Facilities Construction and Management****INSTRUCTION AND SUBCONTRACTORS LIST FORM**

The three low bidders, as well as all other bidders that desire to be considered, are required by law to submit to DFCM within 24 hours of bid opening a list of **ALL** first-tier subcontractors, including the subcontractor's name, bid amount and other information required by Building Board Rule and as stated in these Contract Documents, based on the following:

DOLLAR AMOUNTS FOR LISTING

PROJECTS UNDER \$500,000: ALL FIRST-TIER SUBS \$20,000 OR OVER MUST BE LISTED
PROJECTS \$500,000 OR MORE: ALL FIRST-TIER SUBS \$35,000 OR OVER MUST BE LISTED

- Any additional subcontractors identified in the bid documents shall also be listed.
- The DFCM Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law.
- List subcontractors for base bid as well as the impact on the list that the selection of any alternate may have.
- Bidder may not list more than one subcontractor to perform the same work.
- If there are no subcontractors for the job that are required to be reported by State law (either because there are no subcontractors that will be used on the project or because there are no first-tier subcontractors over the dollar amounts referred to above), then you do not need to submit a sublist. If you do not submit a sublist, it will be deemed to be a representation by you that there are no subcontractors on the job that are required to be reported under State law. At any time, DFCM reserves the right to inquire, for security purposes, as to the identification of the subcontractors at any tier that will be on the worksite.

LICENSURE:

The subcontractor's name, the type of work, the subcontractor's bid amount, and the subcontractor's license number as issued by DOPL, if such license is required under Utah Law, shall be listed. Bidder shall certify that all subcontractors, required to be licensed, are licensed as required by State law. A subcontractor includes a trade contractor or specialty contractor and does not include suppliers who provide only materials, equipment, or supplies to a contractor or subcontractor.

'SPECIAL EXCEPTION':

A bidder may list 'Special Exception' in place of a subcontractor when the bidder intends to obtain a subcontractor to perform the work at a later date because the bidder was unable to obtain a qualified or reasonable bid under the provisions of U.C.A. Section 63A-5-208(4). The bidder shall insert the term 'Special Exception' for that category of work, and shall provide documentation with the subcontractor list describing the bidder's efforts to obtain a bid of a qualified subcontractor at a reasonable cost and why the bidder was unable to obtain a qualified subcontractor bid. The Director must find that the bidder complied in good faith with State law requirements for any 'Special Exception' designation, in order for the bid to be considered. If awarded the contract, the Director shall supervise the bidder's efforts to obtain a qualified subcontractor bid. The amount of the awarded contract may not be adjusted to reflect the actual amount of the subcontractor's bid. Any listing of 'Special Exception' on the sublist form shall also include amount allocated for that work.

GROUNDS FOR DISQUALIFICATION:

The Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law. Director may withhold awarding the contract to a particular bidder if one or more of the proposed subcontractors are considered by the Director to be unqualified to do the Work or for such

INSTRUCTIONS AND SUBCONTRACTORS LIST FORM
Page No. 2

other reason in the best interest of the State of Utah. Notwithstanding any other provision in these instructions, if there is a good faith error on the sublist form, at the sole discretion of the Director, the Director may provide notice to the contractor and the contractor shall have 24 hours to submit the correction to the Director. If such correction is submitted timely, then the sublist requirements shall be considered met.

CHANGES OF SUBCONTRACTORS SPECIFICALLY IDENTIFIED ON SUBLIST FORM:

Subsequent to twenty-four hours after the bid opening, the contractor may change its listed subcontractors only after receiving written permission from the Director based on complying with all of the following criteria.

- (1) The contractor has established in writing that the change is in the best interest of the State and that the contractor establishes an appropriate reason for the change, which may include, but not is not limited to, the following reasons: the original subcontractor has failed to perform, or is not qualified or capable of performing, and/or the subcontractor has requested in writing to be released.
- (2) The circumstances related to the request for the change do not indicate any bad faith in the original listing of the subcontractors.
- (3) Any requirement set forth by the Director to ensure that the process used to select a new subcontractor does not give rise to bid shopping.
- (4) Any increase in the cost of the subject subcontractor work is borne by the contractor.
- (5) Any decrease in the cost of the subject subcontractor work shall result in a deductive change order being issued for the contract for such decreased amount.
- (6) The Director will give substantial weight to whether the subcontractor has consented in writing to being removed unless the Contractor establishes that the subcontractor is not qualified for the work.

EXAMPLE:

Example of a list where there are only four subcontractors:

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONTRACTOR LICENSE #
ELECTRICAL	ABCD Electric Inc.	\$350,000.00	123456789000
LANDSCAPING	"Self" *	\$300,000.00	123456789000
CONCRETE (ALTERNATE #1)	XYZ Concrete Inc	\$298,000.00	987654321000
MECHANICAL	"Special Exception" (attach documentation)	Fixed at: \$350,000.00	(TO BE PROVIDED AFTER OBTAINING SUBCONTRACTOR)

* Bidders may list "self", but it is not required.

PURSUANT TO STATE LAW - SUBCONTRACTOR BID AMOUNTS CONTAINED IN THIS SUBCONTRACTOR LIST SHALL NOT BE DISCLOSED UNTIL THE CONTRACT HAS BEEN AWARDED.

CONTRACTOR'S AGREEMENT

FOR:

THIS CONTRACTOR'S AGREEMENT, made and entered into this ____ day of _____, 20__, by and between the DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT, hereinafter referred to as "DFCM", and _____, incorporated in the State of _____ and authorized to do business in the State of Utah, hereinafter referred to as "Contractor", whose address is _____.

WITNESSETH: WHEREAS, DFCM intends to have Work performed at _____
_____.

WHEREAS, Contractor agrees to perform the Work for the sum stated herein.

NOW, THEREFORE, DFCM and Contractor for the consideration provided in this Contractor's Agreement, agree as follows:

ARTICLE 1. SCOPE OF WORK. The Work to be performed shall be in accordance with the Contract Documents prepared by _____ and entitled "_____."

The DFCM General Conditions ("General Conditions") dated May 25, 2005 and Supplemental General Conditions dated July 15, 2008 ("also referred to as General Conditions") and on file at the office of DFCM and available on the DFCM website, are hereby incorporated by reference as part of this Agreement and are included in the specifications for this Project. All terms used in this Contractor's Agreement shall be as defined in the Contract Documents, and in particular, the General Conditions.

The Contractor Agrees to furnish labor, materials and equipment to complete the Work as required in the Contract Documents which are hereby incorporated by reference. It is understood and agreed by the parties hereto that all Work shall be performed as required in the Contract Documents and shall be subject to inspection and approval of DFCM or its authorized representative. The relationship of the Contractor to the DFCM hereunder is that of an independent Contractor.

ARTICLE 2. CONTRACT SUM. The DFCM agrees to pay and the Contractor agrees to accept in full performance of this Contractor's Agreement, the sum of _____ DOLLARS AND NO CENTS (\$_____.00), which is the base bid, and which sum also includes the cost of a 100%

CONTRACTOR'S AGREEMENT
PAGE NO. 2

Performance Bond and a 100% Payment Bond as well as all insurance requirements of the Contractor. Said bonds have already been posted by the Contractor pursuant to State law. The required proof of insurance certificates have been delivered to DFCM in accordance with the General Conditions before the execution of this Contractor's Agreement.

ARTICLE 3. TIME OF COMPLETION AND DELAY REMEDY. The Work shall be Substantially Complete by _____. Contractor agrees to pay liquidated damages in the amount of \$_____ per day for each day after expiration of the Contract Time until the Contractor achieves Substantial Completion in accordance with the Contract Documents, if Contractor's delay makes the damages applicable. The provision for liquidated damages is: (a) to compensate the DFCM for delay only; (b) is provided for herein because actual damages can not be readily ascertained at the time of execution of this Contractor's Agreement; (c) is not a penalty; and (d) shall not prevent the DFCM from maintaining Claims for other non-delay damages, such as costs to complete or remedy defective Work.

No action shall be maintained by the Contractor, including its or Subcontractor or suppliers at any tier, against the DFCM or State of Utah for damages or other claims due to losses attributable to hindrances or delays from any cause whatsoever, including acts and omissions of the DFCM or its officers, employees or agents, except as expressly provided in the General Conditions. The Contractor may receive a written extension of time, signed by the DFCM, in which to complete the Work under this Contractor's Agreement in accordance with the General Conditions.

ARTICLE 4. CONTRACT DOCUMENTS. The Contract Documents consist of this Contractor's Agreement, the Conditions of the Contract (DFCM General Conditions, Supplementary and other Conditions), the Drawings, Specifications, Addenda and Modifications. The Contract Documents shall also include the bidding documents, including the Notice to Contractors, Instructions to Bidders/Proposers and the Bid/Proposal, to the extent not in conflict therewith and other documents and oral presentations that are documented as an attachment to the contract.

All such documents are hereby incorporated by reference herein. Any reference in this Contractor's Agreement to certain provisions of the Contract Documents shall in no way be construed as to lessen the importance or applicability of any other provisions of the Contract Documents.

ARTICLE 5. PAYMENT. The DFCM agrees to pay the Contractor from time to time as the Work progresses, but not more than once each month after the date of Notice to Proceed, and only upon Certificate of the A/E for Work performed during the preceding calendar month, ninety-five percent (95%) of the value of the labor performed and ninety-five percent (95%) of the value of materials furnished in place or on the site. The Contractor agrees to furnish to the DFCM invoices for materials purchased and on the site but not installed, for which the Contractor requests payment and agrees to safeguard and protect such equipment or materials and is responsible for safekeeping thereof and if such be stolen, lost or destroyed, to replace same.

Such evidence of labor performed and materials furnished as the DFCM may reasonably require shall be supplied by the Contractor at the time of request for Certificate of Payment on account. Materials for which payment has been made cannot be removed from the job site without DFCM's written approval. Five percent (5%) of the earned amount shall be retained from each monthly payment. The retainage, including any additional retainage imposed and the release of any retainage, shall be in accordance with UCA 13-8-5 as amended. Contractor shall also comply with the requirements of UCA 13-8-5, including restrictions of retainage regarding subcontractors and the distribution of interest earned on the retention proceeds. The DFCM shall not be responsible for enforcing the Contractor's obligations under State law in fulfilling the retention law requirements with subcontractors at any tier.

ARTICLE 6. INDEBTEDNESS. Before final payment is made, the Contractor must submit evidence satisfactory to the DFCM that all payrolls, materials bills, subcontracts at any tier and outstanding indebtedness in connection with the Work have been properly paid. Final Payment will be made after receipt of said evidence, final acceptance of the Work by the DFCM as well as compliance with the applicable provisions of the General Conditions.

Contractor shall respond immediately to any inquiry in writing by DFCM as to any concern of financial responsibility and DFCM reserves the right to request any waivers, releases or bonds from Contractor in regard to any rights of Subcontractors (including suppliers) at any tier or any third parties prior to any payment by DFCM to Contractor.

ARTICLE 7. ADDITIONAL WORK. It is understood and agreed by the parties hereto that no money will be paid to the Contractor for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the General Conditions and the Contract Documents for such additional labor or materials has been executed. The DFCM specifically reserves the right to modify or amend this Contractor's Agreement and the total sum due hereunder either by enlarging or restricting the scope of the Work.

ARTICLE 8. INSPECTIONS. The Work shall be inspected for acceptance in accordance with the General Conditions.

ARTICLE 9. DISPUTES. Any dispute, PRE or Claim between the parties shall be subject to the provisions of Article 7 of the General Conditions. DFCM reserves all rights to pursue its rights and remedies as provided in the General Conditions.

ARTICLE 10. TERMINATION, SUSPENSION OR ABANDONMENT. This Contractor's Agreement may be terminated, suspended or abandoned in accordance with the General Conditions.

ARTICLE 11. DFCM'S RIGHT TO WITHHOLD CERTAIN AMOUNT AND MAKE USE THEREOF. The DFCM may withhold from payment to the Contractor such amount as, in DFCM's judgment, may be necessary to pay just claims against the Contractor or Subcontractor at any tier for labor and services rendered and materials furnished in and about the Work. The DFCM may apply such withheld amounts for the payment of such claims in DFCM's discretion. In so doing, the DFCM shall be deemed the agent of Contractor and payment so made by the DFCM shall be considered as payment made under this Contractor's Agreement by the DFCM to the Contractor. DFCM shall not be liable to the Contractor for any such payment made in good faith. Such withholdings and payments may be made without prior approval of the Contractor and may be also be prior to any determination as a result of any dispute, PRE, Claim or litigation.

ARTICLE 12. INDEMNIFICATION. The Contractor shall comply with the indemnification provisions of the General Conditions.

ARTICLE 13. SUCCESSORS AND ASSIGNMENT OF CONTRACT. The DFCM and Contractor, respectively bind themselves, their partners, successors, assigns and legal representatives to the other party to this Agreement, and to partners, successors, assigns and legal representatives of such other party with respect to all covenants, provisions, rights and responsibilities of this Contractor's Agreement. The Contractor shall not assign this Contractor's Agreement without the prior written consent of the DFCM, nor shall the Contractor assign any moneys due or to become due as well as any rights under this Contractor's Agreement, without prior written consent of the DFCM.

ARTICLE 14. RELATIONSHIP OF THE PARTIES. The Contractor accepts the relationship of trust and confidence established by this Contractor's Agreement and covenants with the DFCM to cooperate with the DFCM and A/E and use the Contractor's best skill, efforts and judgment in furthering the interest of the DFCM; to furnish efficient business administration and supervision; to make best efforts to furnish at all times an adequate supply of workers and materials; and to perform the Work in the best and most expeditious and economic manner consistent with the interests of the DFCM.

ARTICLE 15. AUTHORITY TO EXECUTE AND PERFORM AGREEMENT. Contractor and DFCM each represent that the execution of this Contractor's Agreement and the performance thereunder is within their respective duly authorized powers.

ARTICLE 16. ATTORNEY FEES AND COSTS. Except as otherwise provided in the dispute resolution provisions of the General Conditions, the prevailing party shall be entitled to reasonable attorney fees and costs incurred in any action in the District Court and/or appellate body to enforce this Contractor's Agreement or recover damages or any other action as a result of a breach thereof.

PERFORMANCE BOND
(Title 63, Chapter 56, U. C. A. 1953, as Amended)

That _____ hereinafter referred to as the "Principal" and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah, hereinafter referred to as the "Obligee," in the amount of _____ DOLLARS (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____, for the approximate sum of _____ Dollars (\$ _____), which Contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall faithfully perform the Contract in accordance with the Contract Documents including, but not limited to, the Plans, Specifications and conditions thereof, the one year performance warranty, and the terms of the Contract as said Contract may be subject to Modifications or changes, then this obligation shall be void; otherwise it shall remain in full force and effect.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the state named herein or the heirs, executors, administrators or successors of the Owner.

The parties agree that the dispute provisions provided in the Contract Documents apply and shall constitute the sole dispute procedures of the parties.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the Provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____

(Seal)

Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____

Attorney-in-Fact (Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney in-fact of the above-named Surety Company and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.

My commission expires: _____

Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

PAYMENT BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____ authorized to do business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of _____, hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah hereinafter referred to as the "Obligee," in the amount of _____ Dollars (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____ for the approximate sum of _____ Dollars (\$ _____), which contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall pay all claimants supplying labor or materials to Principal or Principal's Subcontractors in compliance with the provisions of Title 63, Chapter 56, of Utah Code Annotated, 1953, as amended, and in the prosecution of the Work provided for in said Contract, then, this obligation shall be void; otherwise it shall remain in full force and effect.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____ (Seal)
Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____ (Seal)
Attorney-in-Fact

STATE OF _____)
) ss.
COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.

My commission expires: _____

Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General



Division of Facilities Construction and Management

DFCM

CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT _____ PROJECT NO: _____

AGENCY/INSTITUTION _____

AREA ACCEPTED _____

The Work performed under the subject Contract has been reviewed on this date and found to be Substantially Completed as defined in the General Conditions; including that the construction is sufficiently completed in accordance with the Contract Documents, as modified by any change orders agreed to by the parties, so that the State of Utah can occupy the Project or specified area of the Project for the use for which it is intended.

The DFCM - (Owner) accepts the Project or specified area of the Project as Substantially Complete and will assume full possession of the Project or specified area of the Project at _____ (time) on _____ (date).

The DFCM accepts the Project for occupancy and agrees to assume full responsibility for maintenance and operation, including utilities and insurance, of the Project subject to the itemized responsibilities and/or exceptions noted below:

The Owner acknowledges receipt of the following closeout and transition materials:

- Record Drawings
- O & M Manuals
- Warranty Documents
- Completion of Training Requirements

A list of items to be completed or corrected (Punch List) is attached hereto. The failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents, including authorized changes thereof. The amount of _____. (Twice the value of the punch list work) shall be retained to assure the completion of the punch list work.

The Contractor shall complete or correct the Work on the list of (Punch List) items appended hereto within _____ calendar days from the above date of issuance of this Certificate. If the list of items is not completed within the time allotted the Owner has the right to be compensated for the delays and/or complete the work with the help of independent contractor at the expense of the retained project funds. If the retained project funds are insufficient to cover the delay/completion damages, the Owner shall be promptly reimbursed for the balance of the funds needed to compensate the Owner.

CONTRACTOR (include name of firm) by: _____
(Signature) DATE

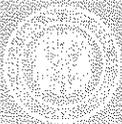
A/E (include name of firm) by: _____
(Signature) DATE

USING INSTITUTION OR AGENCY by: _____
(Signature) DATE

DFCM (Owner) by: _____
(Signature) DATE

4110 State Office Building, Salt Lake City, Utah 84114
telephone 801-538-3018 • facsimile 801-538-3267 • <http://dfcm.utah.gov>

cc: Parties Noted
DFCM, Director

**General Contractor Performance Rating Form**

Project Name:		DFCM Project#	
Contractor: (ABC Construction, John Doe, 111-111-1111)	A/E: (ABC Architects, Jane Doe, 222-222-2222)	Original Contract Amount:	Final Contract Amount:
DFCM Project Manager:		Contract Date:	
Completion Date:		Date of Rating:	

Rating Guideline	QUALITY OF PRODUCT OR SERVICES	COST CONTROL	TIMELINESS OF PERFORMANCE	BUSINESS RELATIONS
5-Exceptional	Contractor has demonstrated an exceptional performance level in any of the above four categories that justifies adding a point to the score. Contractor performance clearly exceeds the performance levels described as "Very Good"			
4-Very Good	Contractor is in compliance with contract requirements and/or delivers quality product/service.	Contractor is effective in managing costs and submits current, accurate, and complete billings	Contractor is effective in meeting milestones and delivery schedule	Response to inquiries, technical/service/administrative issues is effective
3-Satisfactory	Minor inefficiencies/errors have been identified	Contractor is usually effective in managing cost	Contractor is usually effective in meeting milestones and delivery schedules	Response to inquires technical/service/administrative issues is somewhat effective
2-Marginal	Major problems have been encountered	Contractor is having major difficulty managing cost effectively	Contractor is having major difficulty meeting milestones and delivery schedule	Response to inquiries, technical/service/administrative issues is marginally effective
1-Unsatisfactory	Contractor is not in compliance and is jeopardizing achievement of contract objectives	Contractor is unable to manage costs effectively	Contractor delays are jeopardizing performance of contract objectives	Response to inquiries, technical/service/administrative issues is not effective

1. Rate Contractors quality of workmanship, management of sub contractor performance, project cleanliness, organization and safety requirement.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

2. Rate Contractor administration of project costs, change orders and financial management of the project budget.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

3. Rate Contractor's performance and adherence to Project Schedule, delay procedures and requirements of substantial completion, inspection and punch-list performance.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

4. Evaluate performance of contractor management team including project manager, engineer and superintendent also include in the rating team's ability to work well with owner, user agency and consultants.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

5. Rate success of Contractor's management plan, completion of the plans mitigation of project risks and performance of value engineering concepts.	Score
<u>Agency Comments:</u>	
<u>A & E Comments:</u>	
<u>DFCM Project Manager Comments:</u>	

Signed by:	Date:	Mean Score
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Additional Comments:

PROJECT MANUAL

Davis Applied Technical College

Remodel of Cosmetology Area

State of Utah DFCM

Construction Documents Submittal

PROJECT NO.: 07264500

ISSUE DATE: November 12, 2008

ISSUED FOR: Review

**SCHEER & SCHEER INC.
776 N. EAST CAPITOL BLVD
SALT LAKE CITY, UTAH 84103
801.355.1303**

Davis Applied Technical College
Remodel or Cosmetology Area
Construction Document Submittal

Table of Contents - Specifications

DIVISION 01 - GENERAL REQUIREMENTS

011000	Summary
012900	Payment Procedures
013100	Project Management and Coordination
013300	Submittal Procedures
015000	Temporary Facilities
017329	Cutting and Patching
017419	Construction Waste Management and Disposal
017823	Operation and Maintenance Data

DIVISION 02 – EXISTING CONDITIONS

024119	Selective Structure Demolition
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DIVISION 03 - CONCRETE

Not Applicable

DIVISION 04 - MASONRY

042200	Concrete Unit Masonry
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DIVISION 05 - METALS

Not Applicable

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

064023	Interior Architectural Woodwork
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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

079200	Joint Sealants
--------	----------------

DIVISION 08 - OPENINGS

081113	Hollow Metal Doors and Frames
083323	Overhead Coiling Doors
084113	Aluminum-Framed Entrances and Storefronts
084229	Automatic Entrances
087100	Door Hardware
088000	Glazing

DIVISION 09 - FINISHES

092216 Non-Structural Metal Framing
092900 Gypsum Board
095113 Acoustical Panel Ceiling
096513 Resilient Base and Accessories
096516 Resilient Sheet Flooring
096816 Sheet Carpeting
097700 Fiberglass Reinforced Panels
099123 Interior Painting

DIVISION 10 - SPECIALTIES

102800 Toilet, Bath and Laundry Accessories

DIVISION 11 – EQUIPMENT

Not Applicable

DIVISION 12 - FURNISHINGS

Not Applicable

DIVISION 13 - SPECIAL CONSTRUCTION

Not Applicable

DIVISION 14 - CONVEYING EQUIPMENT

Not Applicable

DIVISION 21 – FIRE SUPPRESSION

210500 Common Work Results for Fire Suppression
210548 Vibration & Seismic controls for Fire-Suppression Piping & Equipment
211212 Wet-Pipe Sprinkler System

DIVISION 22 – PLUMBING

220500 Common Work Results for Plumbing
220523 General-Duty Valves for Plumbing Piping
220529 Hangers and Supports for Plumbing Piping and Equipment
220548 Vibration and Seismic Controls fro Plumbing Piping & Equipment
220553 Identification for Plumbing Piping and Equipment
220700 Plumbing Insulation
221116 Domestic Water Piping
221119 Domestic Water Piping Specialties
221316 Sanitary Waste and Vent Piping
221319 Sanitary Waste Piping Specialties
224000 Plumbing Fixtures

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

230500 Common Work Results for HVAC
230513 Common Motor Requirements for HVAC Equipment
230523 General-Duty Valves for HVAC Piping

230529 Hangers and Supports for HVAC Piping and Equipment
230548 Vibration and Seismic Controls for HVAC Piping and Equipment
230553 Identification for HVAC Piping and Equipment
230594 Testing, Adjusting and Balancing for HVAC – Air/Hydronic
230700 HVAC Insulation
230900 Instrumentation and Control for HVAC – DDC
230993 Sequence of Operation for HVAC Controls
232113 Hydronic Piping
233113 Metal Ducts
233300 Air Duct Accessories
233423 HVAC Power Ventilators
233600 Air Terminal Units
233713 Diffusers, Registers and Grilles

DIVISION 26 - ELECTRICAL

260500 Basic Electrical Materials and Methods
260519 Wires and Cables
260533 Raceways
262726 Switches and Receptacles
265000 Lighting
26111 Surface Raceway Systems
26122 Metal Clad Cable
26723 Fire Alarm Systems (Existing)
26950 Occupancy Sensed Lighting Control

DIVISION 27 – COMMUNICATIONS

270500 Voice/Data System Wiring

DIVISION 31 – EARTHWORK

Not Applicable

DIVISION 32 – EXTERIOR IMPROVEMENTS

Not Applicable

DIVISION 33 – UTILITIES

Not Applicable

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and drawing conventions.

B. Related Section:

1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Davis Applied Technical College Cosmetology Department Building Renovation.

1. Project Location: Kaysville, Utah campus.

B. Owner: State of Utah DFCM.

1. Owner's Representative: Lucas Davis.

C. Architect: Scheer & Scheer, Inc..

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and consists of the following:

1. Remodel of Main Campus Building Cosmetology Department area, reusing as much material as possible from existing conditions.

B. Type of Contract.

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

1.4 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.
- 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.

1.5 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 - 2. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.6 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours, except as otherwise indicated.

- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Architect and Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Architect's and Owner's written permission before proceeding with utility interruptions.
- D. 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 Architect and Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Architect's and Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.
- F. Controlled Substances: Use of tobacco products and other controlled substances on the Project site is not permitted.

1.7 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 the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

Davis Applied Technical College
Remodel of Cosmetology Area

Scheer & Scheer, Inc.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 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. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use 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. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. 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 multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.
 - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
6. 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.
7. 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.
8. 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.

1.3 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. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 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.
- E. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. 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 (preliminary if not final).
 4. Schedule of unit prices.
 5. Submittal schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. List of Contractor's principal consultants.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Initial progress report.
 11. Report of preconstruction conference.
 12. Certificates of insurance and insurance policies.
- 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. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706-1994, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A-1994, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707-1994, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination drawings.
 - 2. Requests for Information (RFIs).
 - 3. Project meetings.

1.2 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information from each other during construction.

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

4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.

1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings.
 3. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility.

1.5 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.

2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: AIA Document G716.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number including RFIs that were dropped and not submitted.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

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: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 - 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. 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. Tentative construction schedule.
 - 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 RFIs.
 - f. Procedures for testing and inspecting.
 - g. Procedures for processing Applications for Payment.
 - h. Distribution of the Contract Documents.
 - i. Submittal procedures.
 - j. Preparation of record documents.
 - k. Use of the premises and existing building.
 - l. Work restrictions.
 - m. Working hours.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Procedures for moisture and mold control.
 - q. Procedures for disruptions and shutdowns.
 - r. Construction waste management and recycling.
 - s. Parking availability.
 - t. Office, work, and storage areas.
 - u. Equipment deliveries and priorities.
 - v. First aid.
 - w. Security.
 - x. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.

- q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals.
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 meeting 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) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.

- 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections:
 - 1. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 - 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement

- B. 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.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 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 for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - f. Name of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.

- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 4. Include the following information on an inserted cover sheet:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Related physical samples submitted directly.
 - m. Other necessary identification.
- F. Options: Identify options requiring selection by the Architect.
- G. Deviations: Identify deviations from the Contract Documents on submittals.
- H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in 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.
- I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
1. Transmittal Form: Use AIA Document G810.
 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 in the

Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

- J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- K. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- L. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements:
 - 1. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Action Submittals: Submit three paper copies of each submittal, unless otherwise indicated. Architect will return two copies.
 - 3. Informational Submittals: Submit two paper copies of each submittal, unless otherwise indicated. Architect will not return copies.
 - 4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:

- a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in the following format:
 - a. PDF electronic file.
 - b. Three paper copies of Product Data, unless otherwise indicated. Architect will return two copies.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: 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 42 inches.
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 - b. Two opaque (bond) copies of each submittal. Architect will return one copy.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 3. 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.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Submit product schedule in the following format:
 - a. PDF electronic file.
 - b. Three paper copies of product schedule or list, unless otherwise indicated. Architect will return two copies.

- F. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- G. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- 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.
 - 1. Submit subcontract list in the following format:
 - a. PDF electronic file.
 - b. Number of Copies: Three paper copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
- I. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- J. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- K. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.
- L. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- M. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- P. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- Q. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

- R. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- S. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- T. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- U. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- V. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- 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.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Section:
 - 1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer 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.
- C. 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.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate project meetings specified in other Division 01 Sections. Keep office clean and orderly.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 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

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

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: 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.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. 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 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.
- G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
 - 1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine in each field office.
 - 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.
 - g. Principal subcontractors' field and home offices.
 - 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- J. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access project electronic documents and maintain electronic communications. Equip computer with not less than the following:
 - 1. Processor: Intel Pentium D or Intel CoreDuo, 1.8 GHz processing speed.
 - 2. Memory: 2 gigabyte.
 - 3. Disk storage: 80 gigabyte hard disk drive and combination DVD-RW/CD-RW drive.
 - 4. Display: 19-inch LCD monitor with 128 Mb dedicated video RAM.
 - 5. Network Connectivity: 10/100BaseT Ethernet.
 - 6. Productivity Software:
 - a. Microsoft Office Professional, XP or higher, including Word, Excel, and Outlook.
 - b. Adobe Reader 7.0 or higher.
 - c. WinZip 7.0 or higher.
 - 7. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these 3 functions.

8. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 384 Kbps upload and 1 Mbps download speeds at each computer.
9. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing and spam protection in a combined application.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

D. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

B. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

C. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.

3. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 4. Protect air-handling equipment.
 5. Provide walk-off mats at each entrance through temporary partition.
- D. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Prohibit smoking in construction areas.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -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.

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.
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: 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.

END OF SECTION 015000

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. See Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 - 7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.3 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.
- 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.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous 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.

- 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.

1.4 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.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place 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 in-place 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 in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption 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.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. 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.
 - 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 in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Sections:
 - 1. Division 02 Section "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.
 - 2. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 QUALITY ASSURANCE

- A. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 2. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
- B. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- C. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

- D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- E. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- F. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- G. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- H. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

- 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
- 2. Polystyrene Packaging: Separate and bag materials.
- 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
- 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

- 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
- 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

- 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Sections:
 - 1. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 CLOSEOUT SUBMITTALS

- A. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 - 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- B. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or modify each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Architect.
 7. Name and contact information for Commissioning Agent.
 8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 9. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.

- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.

- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

2.3 OPERATION MANUALS

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

7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

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

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source

information, maintenance service contracts, and warranty and bond information, as described below.

- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.

END OF SECTION 017823

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 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. See Division 01 Section "Construction Waste Management and Disposal" for disposal of demolished materials.

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

1.3 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each activity, interruption of utility services, use of elevator and stairs, and locations of temporary partitions and means of egress.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
 - 1. Comply with submittal requirements in Division 01 Section "Construction Waste Management and Disposal."

1.4 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. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at Project site.

1.5 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.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. 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.

1.6 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.

- 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.

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.
- 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.

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.
- 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.

3.4 SELECTIVE DEMOLITION

- 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. 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.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3. 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 portable fire-suppression devices during flame-cutting operations.
4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."

B. 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.

- C. 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 and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 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. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

- B. Burning: Do not burn demolished materials.

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

3.6 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.

END OF SECTION 024119

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU's).

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each type and color of exposed masonry unit – match existing.
- C. Material Certificates: For each type and size of product indicated. For masonry units include data on material properties.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1.3 QUALITY ASSURANCE

- A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.4 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

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.

- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 - 2. Density Classification: Normal weight.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Water: Potable.

2.4 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.
- 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.
 - 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.
 - 2. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.

PART 3 - EXECUTION

3.1 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 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.
2. 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.

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.

3.2 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. 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.

3.3 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

- C. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780.
- D. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.4 MASONRY WASTE DISPOSAL

- A. Excess Masonry Waste: Remove excess clean masonry waste and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Plastic-laminate countertops.

1.2 SUBMITTALS

- A. Samples:
 - 1. Plastic-laminates, for each type, color, pattern, and surface finish.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

2.2 MISCELLANEOUS MATERIALS

- A. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

2.3 FABRICATION

- A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
- B. Plastic-Laminate Countertops:
 - 1. High-Pressure Decorative Laminate Grade: HGS.
 - 2. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of solid colors, patterns, gloss or matte finish.
 - 3. Edge Treatment: As indicated.
 - 4. Core Material at Sinks: Particleboard made with exterior glue.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.
- B. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches. Shim as required with concealed shims.
- C. Scribe and cut woodwork to fit adjoining work, 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 or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- E. Countertops: Anchor securely by screwing through corner blocks of cabinets or other supports into underside of countertop. Calk space between wall with sealant specified in Division 07 Section "Joint Sealants."

END OF SECTION 064023

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Latex joint sealants.

1.2 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Product test reports.
- C. Warranties.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.4 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. 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.

- B. 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.
- C. 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 SILICONE JOINT SEALANTS

- A. Mildew-Resistant Silicone Joint Sealant : ASTM C 920.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. May National Associates, Inc.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Schnee-Morehead, Inc.
 - h. Sika Corporation; Construction Products Division.
 - i. Tremco Incorporated.
 - 2. Type: Single component (S) or multicomponent (M).
 - 3. Grade: Pourable (P) or [nonsag (NS)].
 - 4. Class: 100/50.
 - 5. Uses Related to Exposure: Traffic (T) or Nontraffic (NT).

2.3 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems.
 - b. Bostik, Inc.
 - c. May National Associates, Inc.
 - d. Pecora Corporation.
 - e. Schnee-Morehead, Inc.
 - f. Tremco Incorporated.

2.4 JOINT SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.5 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.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- 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 in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- F. 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.

3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Perimeter joints between materials and frame of doors and windows
 - b. Other joints as indicated.
 - 2. Joint Sealant: Silicone.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- B. Joint-Sealant Application: 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. Vertical joints on exposed surfaces of interior unit masonry, walls and partitions.
 - d. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - e. Other joints as indicated.
 - 2. Joint Sealant: Latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Other joints as indicated.
 - 2. Joint Sealant: Silicone.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
 - 4. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Standard hollow metal doors and frames.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Samples for Verification: For each type of exposed finish required.

1.3 QUALITY ASSURANCE

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
- B. Fire-Rated, Borrowed-Light Frame 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 257 or UL 9. Label each individual glazed lite.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Amweld Building Products, LLC.
 - 2. Benchmark; a division of Therma-Tru Corporation.
 - 3. Ceco Door Products; an Assa Abloy Group company.
 - 4. Curries Company; an Assa Abloy Group company.
 - 5. Deansteel Manufacturing Company, Inc.
 - 6. Firedoor Corporation.
 - 7. Fleming Door Products Ltd.; an Assa Abloy Group company.

8. Habersham Metal Products Company.
9. Kewanee Corporation (The).
10. Mesker Door Inc.
11. Pioneer Industries, Inc.
12. Security Metal Products Corp.
13. Steelcraft; an Ingersoll-Rand company.
14. Windsor Republic Doors.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- G. Glazing: Division 08 Section "Glazing."
- H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Comply with ANSI/SDI A250.8.
 1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection ratings indicated.
 3. Vertical Edges for Single-Acting Doors: Manufacturer's standard.
 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick, end closures or channels of same material as face sheets.
 5. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

- B. Interior Doors: Face sheets fabricated from cold-rolled steel sheet . Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

- 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

- C. Hardware Reinforcement: ANSI/SDI A250.6.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8.

- B. Interior Frames: Fabricated from cold-rolled steel sheet.

- 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as knocked down unless otherwise indicated.
 - 3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
 - 4. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
 - 5. Frames for Borrowed Lights: Same as adjacent door frame.

- C. Hardware Reinforcement: ANSI/SDI A250.6.

2.5 FRAME ANCHORS

- A. Jamb Anchors:

- 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

2.6 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, same material as door face sheet.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, same material as frames.
- D. Terminated Stops: Where indicated, terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

2.7 ACCESSORIES

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

2.8 FABRICATION

- A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- B. Hollow Metal Doors:
 - 1. Glazed Lites: Factory cut openings in doors.
- C. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

- 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
- c. Compression Type: Not less than two anchors in each jamb.
- D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
- E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

2.9 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
1. Shop Primer: ANSI/SDI A250.10.
- B. Factory-Applied Paint Finish: ANSI/SDI A250.3.
1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hollow Metal Frames: Comply with ANSI/SDI A250.11.
1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.

- e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
2. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 081113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Service doors.

1.2 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. 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.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance Data.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated.
- B. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from metal to match curtain slats and finish.

- C. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.2 HOOD

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

2.3 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

2.4 CURTAIN ACCESSORIES

- A. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

2.5 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.6 MANUAL DOOR OPERATORS

- A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.
- B. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf .

2.7 DOOR ASSEMBLY

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ACME Rolling Doors.
 - b. Alpine Overhead Doors, Inc.
 - c. AlumaTek, Inc.
 - d. C.H.I. Overhead Doors.
 - e. City-Gates.
 - f. Cookson Company.
 - g. Cornell Iron Works, Inc.
 - h. Dynamic Closures Corp.
 - i. Lawrence Roll-Up Doors, Inc.
 - j. Mahon Door Corporation.
 - k. McKeon Rolling Steel Door Company, Inc.
 - l. Metro Door.
 - m. Overhead Door Corporation.
 - n. QMI Security Solutions.
 - o. Raynor.
 - p. Southwestern Steel Rolling Door Co.
 - q. Wayne-Dalton Corp.
 - r. Windsor Door.
- B. Operation Cycles: Not less than 10,000.
- C. Door Curtain Material: Aluminum.
- D. Door Curtain Slats: Flat profile slats of 1-1/4-inch center-to-center height.
- E. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats.
- F. Hood: Match curtain material and finish.
 - 1. Shape: Round.
 - 2. Mounting: Face of wall.
- G. Locking Devices: Equip door with slide bolt for padlock.
- H. Manual Door Operator: Push-up operation.
- I. Door Finish:
 - 1. Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer.

3.2 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 PERFORMANCE REQUIREMENTS

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

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

B. Wind Loads: As indicated on Drawings.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to $3/4$ inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or $1/8$ inch (3.2 mm), whichever is smaller.

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural

distress, and permanent deformation of main framing members exceeding 0.2 percent of span.

2. Test Durations: 10 seconds.

- E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..
- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
- C. Samples: For each type of exposed finish required.
- D. Product test reports.
- E. Field quality-control reports.
- F. Maintenance data.
- G. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to

verification by one or more methods including preconstruction testing, field testing, and in-service performance.

- E. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- F. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Arcadia, Inc.
 - 2. Arch Aluminum & Glass Co., Inc.
 - 3. CMI Architectural.
 - 4. Commercial Architectural Products, Inc.
 - 5. EFCO Corporation.
 - 6. Kawneer North America; an Alcoa company.
 - 7. Leed Himmel Industries, Inc.
 - 8. Pittco Architectural Metals, Inc.
 - 9. TRACO.
 - 10. Tubelite.
 - 11. United States Aluminum.
 - 12. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
 - 13. YKK AP America Inc.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308M.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 - 1. Structural Shapes, Plates, and Bars: ASTM 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: Nonthermal.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Plane: As indicated.

- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

- D. 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.

- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.5 DOOR SYSTEMS

- A. Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 1. Door Construction: 1-3/4-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 2. Door Design: As indicated – match existing.
 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.6 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.

4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing from interior.
 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Doors: Reinforce doors as required for installing entrance door hardware.
- G. Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
1. Color: Dark bronze – match existing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
1. Comply with manufacturer's written instructions.
 2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Division 08 Section "Glazing."
- G. Doors: Install doors to produce smooth operation and tight fit at contact points.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections.
- B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
 - 1. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 084229 - AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior and interior, sliding, power-operated automatic entrances.

1.2 PERFORMANCE REQUIREMENTS

A. Windborne-Debris-Impact-Resistance-Test Performance: Provide automatic entrances that pass small missile-impact and cyclic-pressure tests of ASTM E 1996 according to the IBC.

B. Opening-Force Requirements:

1. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.
2. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for a breakaway door or panel to open.
3. Accessible Interior Doors: Not more than 5 lbf to fully open door.

C. Entrapment Force Requirements:

1. Power-Operated Sliding Doors: Not more than 30 lbf required to prevent stopped door from closing.

1.3 SUBMITTALS

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

B. Shop Drawings: For automatic entrances. Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.
2. Activation and safety devices.
3. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

C. Sample: For each exposed product and for each color and texture specified.

D. Product certificates.

E. Product test reports.

- F. Field quality-control reports.
- G. Maintenance data.
- H. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.
- B. Certified Inspector Qualifications: Certified by AAADM.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Power-Operated Door Standard: BHMA A156.10.
- E. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as a required means of egress.
- F. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - 2. Sheet and Plate: ASTM B 209.

- 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.
- C. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.
- D. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- E. Glazing: As specified in Division 08 Section "Glazing."
- F. Sealants and Joint Fillers: As specified in Division 07 Section "Joint Sealants."
- G. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107; of consistency suitable for application.
- H. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos; formulated for 30-mil thickness per coat.
- I. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.2 SLIDING AUTOMATIC ENTRANCES

- A. General: Provide manufacturer's standard automatic entrances including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.
- B. Sliding Automatic Entrance: Match existing
 - 1. Manufacturer:
 - a. Access Door Systems
631 W. Sandy Parkway
Sandy, Utah 84070
801.568.3567
John Higley
 - 2. Configuration: Biparting-sliding door(s), with transom and sidelite(s).
 - a. Traffic Pattern: Two way.
 - b. Emergency Breakaway Capability: Sliding leaf(leaves) only.
 - c. Mounting: Between jambs.
 - 3. Operator Features:

- a. Power opening and closing.
 - b. Drive System: Chain or belt.
 - c. Adjustable opening and closing speeds.
 - d. Adjustable hold-open time between 0 and 30 seconds.
 - e. Obstruction recycle.
 - f. On-off/hold-open switch to control electric power to operator, key operated.
4. Sliding Door Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.
- a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.
5. Sliding Door Threshold: Manufacturer's standard threshold members and bottom-guide track system, with stainless-steel, ball-bearing-center roller wheels.
- a. Configuration: Saddle-type threshold across door opening and surface-mounted guide track system at sidelites.
6. Combination Activation and Safety Device: Combination motion/presence sensor.
7. Finish: Finish framing, door(s), sidelite(s), and header with finish matching adjacent storefront.
- a. Color: Dark bronze – match existing.

2.3 ENTRANCE COMPONENTS

- A. Framing and Transom Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.
1. Nominal Size: As indicated on Drawings – match existing.
 2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.
- B. Stile and Rail Doors: Manufacturer's standard 1-3/4-inch- thick, glazed doors with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.
1. Match existing door style
- C. Sidelite(s) and Transom: Manufacturer's standard 1-3/4-inch- deep sidelite(s) and transom with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members matching door design and finish.

1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
 2. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and manufacturer's standard preformed gaskets.
 3. Muntin Bars: Horizontal tubular rail members for each sidelite; match stile design.
- D. Headers: Fabricated from minimum 0.125-inch- thick, extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
1. Mounting: Match existing.
 2. Capacity: Capable of supporting doors up to 175 lb per leaf over spans up to 14 feet without intermediate supports.
- E. Signage: Affixed to both sides of each door as required by BHMA A156.10 and BHMA A156.19 for type of door and its operation.
1. Application Process: Door manufacturer's standard process.

2.4 DOOR OPERATORS AND ACTIVATION AND SAFETY DEVICES

- A. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
1. Door Operator Performance: Provide door operators that will open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
 2. Electromechanical Operators: Concealed, self-contained, overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation with power off.
- B. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units with metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10; with relay hold time of not less than 2 to 10 seconds.
1. Provide capability for switching between bidirectional and unidirectional detection.
 2. For one-way-traffic entrances, sensor on egress side shall not be active when doors are fully closed.
- C. Presence Sensors: Self-contained, infrared-scanner units with metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10; with relay hold time of not less than 2 to 10 seconds. Sensors shall remain active at all times.

- D. Combination Motion/Presence Sensors: Self-contained units; consisting of both motion and presence sensors in a single metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10.
 - 1. Motion Sensor: K-band-frequency, microwave-scanner units; with relay hold time of not less than 2 to 10 seconds.
 - a. Provide capability for switching between bidirectional and unidirectional detection.
 - b. For one-way-traffic entrances, sensor on egress side shall not be active when doors are fully closed.
 - 2. Presence Sensor: Infrared-scanner units; with relay hold time of not less than 2 to 10 seconds. Sensors shall remain active at all times.
- E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.
- F. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator.
 - 1. Configuration: Round push plate with 4-by-4-inch junction box.
 - a. Mounting: Surface mounted on wall.
 - 2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
 - 3. Message: International symbol of accessibility and "Push to Open."
- G. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.5 HARDWARE

- A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish.
- B. Breakaway Device for Power-Operated Doors: Provide breakaway device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be 50 lbf according to BHMA A156.10. Interrupt powered operation of door operator while in breakaway mode.
- C. Hinges:
 - 1. Center-Pivot Sets: BHMA A156.4, Grade 1, with exposed parts of cast-aluminum alloy.
 - 2. Offset Pivots: BHMA A156.4, Grade 1, with exposed parts of cast-aluminum alloy.

3. Butt Hinges: BHMA A156.1, Grade 1, 5-knuckle, 4-1/2-by-4-inch ball-bearing butts.
 - a. Provide nonremovable pins at hinges exposed on outside of door.
 - b. Provide nonferrous hinges for doors exposed to weather.
 - c. Provide 3 hinges at each leaf for doors up to 36 inches wide and 80 inches tall; provide 4 hinges at each leaf for taller doors.
- D. Thresholds: BHMA A156.21, extruded-aluminum raised thresholds; with beveled edges with a slope of not more than 1:2 and a maximum height of 1/2 inch. Provide cutouts as required for door operating hardware.
- E. Weather Stripping: Manufacturer's standard replaceable components.
 1. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
 2. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 3. Weather Sweeps: Manufacturer's standard nylon brush sweep mounted to underside of door bottom.
- F. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket.

2.6 FABRICATION

- A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
- B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
- E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."
- F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
 1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors.
 2. Provide compression-type weather stripping at fixed stops of exterior doors. At locations without fixed stops, provide sliding-type weather stripping retained in adjustable strip mortised into door edge.
 3. Provide weather sweeps mounted to underside of door bottoms of exterior doors.

4. Provide finger guards at each pivoted entrance door that has clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position. Anchor guards to hinge-jamb frame.

G. Activation and Safety Devices:

1. General: Factory install devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:
 - a. Top Beam: 48 inches.
 - b. Bottom Beam: 24 inches.

2.7 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker. Color to match existing

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
 3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
 4. Provide thresholds at exterior doors and where indicated.
- C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

- D. Activation and Safety Devices: Install and adjust devices to provide detection field and functions indicated.
- E. Glazing: Install glazing as specified in Division 08 Section "Glazing."
- F. Sealants: Comply with requirements specified in Division 07 Section "Joint Sealants" to provide weathertight installation.
 - 1. Set thresholds, bottom-guide track system, framing members and flashings in full sealant bed.
 - 2. Seal perimeter of framing members with sealant.
- G. Signage: Apply signage on both sides of each door as required by referenced door standards.
- H. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.
- I. Inspection: Engage Installer's certified inspector to test and inspect automatic entrances and prepare test and inspection reports.
 - 1. Certified inspector shall test and inspect each automatic entrance to determine compliance of installed systems with applicable BHMA standards.
 - 2. Field Quality-Control Report: Certified inspector shall submit report in writing to Architect and Contractor within 24 hours after inspection.
 - 3. Work will be considered defective if it does not pass tests and inspections.
- J. Adjusting: Adjust door operators, controls, and hardware for smooth and safe operation and for weathertight closure; comply with requirements in BHMA A156.10.
 - 1. Readjust door operators and controls after repeated operation of completed installation equivalent to 3 days' use by normal traffic (100 to 300 cycles). Lubricate hardware, operating equipment, and other moving parts.
- K. Demonstration: Engage a certified inspector to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION 084229

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Commercial door hardware.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed finish.
- C. Product certificates.
- D. Other Action Submittals:
 - 1. Door Hardware Sets: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.
 - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - b. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, and material of each door and frame.
 - 2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
 - 3) Complete designations of every item required for each door or opening including name and manufacturer.
 - 4) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
 - 2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.
 - 1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the

course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

- 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 ratings indicated, based on testing according to NFPA 252.
- C. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system.
- D. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver keys to Owner.

1.5 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - a. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in door and frame schedule.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Door Hardware Sets. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

2.2 HINGES, GENERAL

- A. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- B. Hinge Base Metal: Unless otherwise indicated, provide the following:
 1. Interior Hinges: Brass, with stainless-steel pin body and brass protruding heads.
 2. Hinges for Fire-Rated Assemblies: Steel, with steel pin.
- C. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging corridor doors with locks.
- D. Fasteners: Comply with the following:
 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 2. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.3 HINGES

- A. Butts and Hinges: BHMA A156.1.
- B. Template Hinge Dimensions: BHMA A156.7.
- C. Available Manufacturers:
 1. Baldwin Hardware Corporation (BH).
 2. Bommer Industries, Inc. (BI).
 3. Cal-Royal Products, Inc. (CRP).
 4. Hager Companies (HAG).
 5. Lawrence Brothers, Inc. (LB).
 6. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 7. PBB, Inc. (PBB).
 8. Stanley Commercial Hardware; Div. of The Stanley Works (STH).

2.4 LOCKS AND LATCHES, GENERAL

- A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Electrified Locking Devices: BHMA A156.25.
- D. Lock Trim:
 - 1. Levers: Match existing
 - 2. Dummy Trim: Match lever lock trim and escutcheons.
- E. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.
- F. Backset: 2-3/4 inches, unless otherwise indicated.
- G. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.5 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
 - 1. Bored Locks: BHMA A156.2.
 - 2. Mortise Locks: BHMA A156.13.
 - 3. Interconnected Locks: BHMA A156.12.
- B. Bored Locks: BHMA A156.2, Grade 1 unless Grade 2 is indicated; Series 4000.
 - 1. Available Manufacturers:
 - a. Arrow USA; an ASSA ABLOY Group company (ARW).
 - b. Best Access Systems; Div. of The Stanley Works (BAS).
 - c. Cal-Royal Products, Inc. (CRP).
 - d. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
 - e. Falcon Lock; an Ingersoll-Rand Company (FAL).
 - f. Marks USA (MKS).
 - g. Medeco Security Locks, Inc.; an ASSA ABLOY Group company (MED).
 - h. PDQ Manufacturing (PDQ).
 - i. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - j. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).

- k. Security Door Controls (SDC).
 - l. Weiser Lock; a Masco Company (WEI).
 - m. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
- C. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13, Grade 1 unless Grade 2 is indicated; Series 1000.
- 1. Available Manufacturers:
 - a. Accurate Lock & Hardware Co. (ALH).
 - b. Adams Rite Manufacturing Co. (ARM).
 - c. Arrow USA; an ASSA ABLOY Group company (ARW).
 - d. Best Access Systems; Div. of The Stanley Works (BAS).
 - e. Cal-Royal Products, Inc. (CRP).
 - f. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
 - g. Folger Adam Security Inc.; an ASSA ABLOY Group company (FAS).
 - h. Falcon Lock; an Ingersoll-Rand Company (FAL).
 - i. Marks USA (MKS).
 - j. PDQ Manufacturing (PDQ).
 - k. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - l. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
 - m. Security Door Controls (SDC).
 - n. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.6 AUXILIARY LOCKS AND LATCHES

- A. Auxiliary Locks: BHMA A156.5, Grade 1 unless Grade 2 is indicated.
- 1. Available Manufacturers:
 - a. ABLOY Security, Inc.; an ASSA ABLOY Group company (ABL).
 - b. Accurate Lock & Hardware Co. (ALH).
 - c. Adams Rite Manufacturing Co. (ARM).
 - d. Arrow USA; an ASSA ABLOY Group company (ARW).
 - e. Best Access Systems; Div. of The Stanley Works (BAS).
 - f. Cal-Royal Products, Inc. (CRP).
 - g. Falcon Lock; an Ingersoll-Rand Company (FAL).
 - h. Marks USA (MKS).
 - i. Medeco Security Locks, Inc.; an ASSA ABLOY Group company (MED).
 - j. PDQ Manufacturing (PDQ).
 - k. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - l. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
 - m. Weiser Lock; a Masco Company (WEI).
 - n. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.7 EXIT DEVICES

- A. Exit Devices: BHMA A156.3, Grade 1 unless Grade 2 is indicated.
- B. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- F. Available Manufacturers:
 - 1. Adams Rite Manufacturing Co. (ARM).
 - 2. Arrow USA; an ASSA ABLOY Group company (ARW).
 - 3. Cal-Royal Products, Inc. (CRP).
 - 4. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
 - 5. Detex Corporation (DTX).
 - 6. Door Controls International (DCI).
 - 7. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
 - 8. Dor-O-Matic; an Ingersoll-Rand Company (DOR).
 - 9. Locknetics; an Ingersoll-Rand Company (LSE).
 - 10. Monarch Exit Devices & Door Hardware; an Ingersoll-Rand Company (MON).
 - 11. Precision Hardware, Inc. (PH).
 - 12. Rutherford Controls Int'l. Corp. (RCI).
 - 13. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - 14. Von Duprin; an Ingersoll-Rand Company (VD).
 - 15. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.8 LOCK CYLINDERS

- A. Standard Lock Cylinders: BHMA A156.5, Grade 1 unless Grade 2 is indicated.
- B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
 - 1. Number of Pins: Five.
- C. Permanent Cores: Manufacturer's standard; finish face to match lockset; with interchangeable cores.

D. Manufacturer: Same manufacturer as for locks and latches.

E. Available Manufacturers:

1. ABLOY Security, Inc.; an ASSA ABLOY Group company (ABL).
2. Arrow USA; an ASSA ABLOY Group company (ARW).
3. ASSA, Inc.; an ASSA ABLOY Group company (ASA).
4. Best Access Systems; Div. of The Stanley Works (BAS).
5. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
6. Falcon Lock; an Ingersoll-Rand Company (FAL).
7. Medeco Security Locks, Inc.; an ASSA ABLOY Group company (MED).
8. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
9. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
10. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.9 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference into master key system.

1. Existing System: Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel silver; permanently inscribed with a visual key control number and including the notation "DO NOT DUPLICATE."

2.10 OPERATING TRIM

A. Standard: BHMA A156.6.

B. Materials: Match existing, unless otherwise indicated.

C. Available Manufacturers:

1. Burns Manufacturing Incorporated (BM).
2. Don-Jo Mfg., Inc. (DJO).
3. Forms + Surfaces (FS).
4. Hager Companies (HAG).
5. Hiawatha, Inc. (HIA).
6. IVES Hardware; an Ingersoll-Rand Company (IVS).
7. Rockwood Manufacturing Company (RM).
8. Trimco (TBM).

2.11 CLOSERS

A. Accessibility Requirements: Comply with the following maximum opening-force requirements:

1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 2. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
- C. Hold-Open Closers/Detectors: Coordinate and interface integral smoke detector and closer device with fire alarm system.
- D. Flush Floor Plates: Provide finish cover plates for floor closers unless thresholds are indicated. Match door hardware finish, unless otherwise indicated.
- E. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- F. Surface Closers: BHMA A156.4, Grade 1 unless Grade 2 is indicated. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.
1. Available Manufacturers:
 - a. Arrow USA; an ASSA ABLOY Group company (ARW).
 - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
 - c. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
 - d. Dor-O-Matic; an Ingersoll-Rand Company (DOR).
 - e. LCN Closers; an Ingersoll-Rand Company (LCN).
 - f. Norton Door Controls; an ASSA ABLOY Group company (NDC).
 - g. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
 - h. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - i. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
- G. Concealed Closers: BHMA A156.4, Grade 1 unless Grade 2 is indicated.
1. Available Manufacturers:
 - a. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
 - b. LCN Closers; an Ingersoll-Rand Company (LCN).
 - c. Norton Door Controls; an ASSA ABLOY Group company (NDC).
 - d. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
 - e. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).

2.12 STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1 unless Grade 2 is indicated.
 - 1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
- B. Available Manufacturers:
 - 1. Architectural Builders Hardware Mfg., Inc. (ABH).
 - 2. Baldwin Hardware Corporation (BH).
 - 3. Burns Manufacturing Incorporated (BM).
 - 4. Cal-Royal Products, Inc. (CRP).
 - 5. Don-Jo Mfg., Inc. (DJO).
 - 6. Door Controls International (DCI).
 - 7. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
 - 8. Dor-O-Matic; an Ingersoll-Rand Company (DOR).
 - 9. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
 - 10. Hager Companies (HAG).
 - 11. HES, Inc.; an ASSA ABLOY Group company (HES).
 - 12. Hiawatha, Inc. (HIA).
 - 13. IVES Hardware; an Ingersoll-Rand Company (IVS).
 - 14. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
 - 15. Rockwood Manufacturing Company (RM).
 - 16. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - 17. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
 - 18. Trimco (TBM).

2.13 FABRICATION

- A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.
- C. Finishes: BHMA A156.18, as indicated in door hardware sets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.
- B. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.2 DOOR HARDWARE SETS – As shown on drawings

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SUBMITTALS

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

1.3 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.

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.
- 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. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

- C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes basic-protection testing requirements in ASTM E 1996 for Wind Zone 1 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
- D. 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. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 - 2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - 3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Uncoated Tinted Float Glass: Class 2, complying with other requirements specified.
 - 1. Tint Color: As selected by Architect.
- C. Reflective-Coated Vision Glass: ASTM C 1376, coated by pyrolytic process, and complying with other requirements specified.
 - 1. Kind: Kind CV (coated vision glass).
 - 2. Coating Color: As selected by Architect.
 - 3. Glass: Clear float.

2.3 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. Neoprene complying with ASTM C 864.
 - 2. EPDM complying with ASTM C 864.
 - 3. Silicone complying with ASTM C 1115.
 - 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.4 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, 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. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.5 GLAZING TAPES

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

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. 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.

2.7 MONOLITHIC-GLASS TYPES

- A. Glass Type: Clear float glass or fully tempered float glass.
 - 1. Thickness: 6.0 mm.
 - 2. Provide safety glazing labeling.
 - 3. Low e coating where indicated
- B. Glass Type: Tinted float glass or fully tempered float glass.
 - 1. Thickness: 6.0 mm.
 - 2. Provide safety glazing labeling.
 - 3. Low e coating where indicated
- C. Glass Type: Reflective-coated vision glass, float glass or fully tempered float glass.
 - 1. Thickness: 6.0 mm.
 - 2. Coating Location: First surface.
 - 3. Provide safety glazing labeling.
 - 4. Low e coating where indicated

PART 3 - EXECUTION

3.1 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.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

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

3.3 GASKET GLAZING (DRY)

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

3.4 SEALANT GLAZING (WET)

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

3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:
 - 1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
 - 2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

1.2 SUBMITTALS

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

1.3 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.
- B. Sound Transmission Characteristics: For STC-rated assemblies that incorporate non-load-bearing steel framing, 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.

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: manufacturer's standard corrosion-resistant zinc coating, unless otherwise indicated.

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. Flat Hangers: Steel sheet, in size indicated on Drawings.
- D. 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: As indicated on Drawings.
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
 - 2. Steel Studs: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0179 inch.
 - b. Depth: As indicated on Drawings.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base Metal Thickness: 0.0179 inch.
 - 4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.
- F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; 640-C 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: 0.0179 inch.
- B. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.

2. 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.
 3. 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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Steel Network Inc. (The); VertiClip SLD Series.
 - 2) Superior Metal Trim; Superior Flex Track System (SFT).
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.0179 inch.
- D. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- wide flanges.
1. Depth: As indicated on Drawings.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base Metal Thickness: 0.0179 inch.
 2. Depth: As indicated on Drawings.
- F. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical or hat shaped.
- G. Cold-Rolled Furring Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.
1. Depth: As indicated on Drawings.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch.
 3. 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.
- 2.4 AUXILIARY MATERIALS
- A. 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 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

3.2 INSTALLING SUSPENSION SYSTEMS

- A. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- B. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - 3. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 4. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- C. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. 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.
- F. 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.

3.3 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 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.
 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- C. 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.
- D. 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 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.

1.2 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.

1.3 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.

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. American Gypsum Co.
- b. BPB America Inc.
- c. G-P Gypsum.
- d. Lafarge North America Inc.
- e. National Gypsum Company.

- f. PABCO Gypsum.
- g. Temple.
- h. USG Corporation.

B. Regular Type:

- 1. Thickness: 5/8 inch.
- 2. Long Edges: Tapered.

C. Type X:

- 1. Thickness: 5/8 inch.
- 2. Long Edges: Tapered.

D. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

- 1. Thickness: 1/2 inch.
- 2. Long Edges: Tapered.

E. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation and through-penetration (impact resistance) than standard, regular-type and Type X gypsum board.

- 1. Core: 5/8 inch, Type X.
- 2. Long Edges: Tapered.

F. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

- 1. Core: 5/8 inch, Type X.
- 2. Long Edges: Tapered.

2.2 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

- 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
- 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.3 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 setting-type taping compound.
 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.4 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 continuous substrate.
 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 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.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. 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.

3.2 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Regular Type: As indicated on Drawings.
 - 2. Type X: As indicated on Drawings.
 - 3. Ceiling Type: Ceiling surfaces.
 - 4. Abuse-Resistant Type: As indicated on Drawings.
 - 5. Moisture- and Mold-Resistant Type: As indicated on Drawings.

3.3 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 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 - 2. Bullnose Bead: Use at outside corners.
 - 3. LC-Bead: Use at exposed panel edges.
 - 4. U-Bead: Use at exposed panel edges.
- D. Aluminum Trim: Install in locations indicated on Drawings.

3.4 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:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Where indicated on Drawings.
 - 3. Level 3: Where indicated on Drawings.
 - 4. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
 - 5. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.5 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

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:
- C. Samples: For each exposed finish.
- D. Product test reports.
- E. Research/evaluation reports.
- F. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.
- B. Fire-Test-Response Characteristics:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 2. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
 - a. Smoke-Developed Index: 450 or less.
- C. Seismic Standard: Comply with the following:
 - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.

2. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."

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

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Acoustical Panel Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 1. Size: Select wire diameter so its stress at 3 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. Seismic perimeter stabilizer bars, seismic struts, and seismic clips.
- F. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong World Industries, Inc.
2. BPB USA.
3. Chicago Metallic Corporation.
4. Ecophon CertainTeed, Inc.
5. Tectum Inc.
6. USG Interiors, Inc.

B. Classification: Provide panels complying with ASTM E 1264 for type and form as follows:

1. Type and Form: Match existing

C. Color: As selected from manufacturer's full range.

D. Edge/Joint Detail: Square.

E. Thickness: 5/8 inch.

F. Modular Size: As indicated on Drawings.

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong World Industries, Inc.
2. BPB USA.
3. Chicago Metallic Corporation.
4. Ecophon CertainTeed, Inc.
5. USG Interiors, Inc.

B. Double-Web, Fire-Rated 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/A 653M, not less than G30 coating designation, with prefinished 15/16-inch- wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Cap Material: Steel or aluminum cold-rolled sheet.
4. Cap Finish: Match existing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

- B. 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.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. 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.
- 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.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allstate Rubber Corp.; Stoler Industries.
 - b. Armstrong World Industries, Inc.
 - c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - d. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - e. Estrie Products International; American Biltrite (Canada) Ltd.
 - f. Flexco, Inc.
 - g. Johnsonite.
 - h. Mondo Rubber International, Inc.
 - i. Musson, R. C. Rubber Co.
 - j. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
 - k. PRF USA, Inc.
 - l. Roppe Corporation, USA.
 - m. VPI, LLC; Floor Products Division.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TV (vinyl, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe).

C. Minimum Thickness: 0.125 inch.

D. Height: As indicated on Drawings.

E. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: [Job formed.

H. Finish: As selected by Architect from manufacturer's full range.

I. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by 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 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. 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.
- C. Do not install resilient products until they are same temperature as the 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.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl sheet floor covering, with and without backing.

1.2 SUBMITTALS

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

B. Samples: In manufacturer's standard size, but not less than 6-by-9-inch sections of each different color and pattern of floor covering required.

C. Maintenance data.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Chemical Resistance: No color change, surface dulling, or damage to surface when tested in accordance with ASTM F 925.

1.4 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor coverings.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install floor coverings after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL SHEET FLOOR COVERING

- A. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Altro Group.
 - 2. Armstrong World Industries, Inc.
 - 3. Congoleum Corporation.
 - 4. DzynSpec, Division of Matsinc.
 - 5. Forbo Flooring, Inc.
 - 6. Gerflor, Architectural Floor Systems, Inc.
 - 7. Lonseal, Inc.
 - 8. Mannington Mills, Inc.
 - 9. Polyflor, Ltd., Distributed by Gerbert Limited.
 - 10. Tarkett, Inc.
 - 11. TOLI International.
- B. Unbacked Vinyl Sheet Floor Covering: ASTM F 1913, 0.080 inch thick.
- C. Vinyl Sheet Floor Covering with Backing: ASTM F 1303.
 - 1. Type (Binder Content): Type I, minimum binder content of 90 percent.
 - 2. Wear-Layer Thickness: Grade 1.
 - 3. Overall Thickness: [As standard with manufacturer.
 - 4. Interlayer Material: None.
 - 5. Backing Class: Class A (fibrous).
- D. Wearing Surface: Smooth.
- E. Sheet Width: As standard with manufacturer.
- F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
- 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. Proceed with installation only after substrates pass testing.
- C. 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 coverings until they are same temperature as space where they are to be installed.
 - 1. Move floor coverings 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 floor coverings immediately before installation.

3.2 FLOOR COVERING INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor coverings.
- B. Unroll floor coverings and allow them to stabilize before cutting and fitting.
- C. Lay out floor coverings as follows:
 - 1. Maintain uniformity of floor covering direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
 - 3. Match edges of floor coverings for color shading at seams.
 - 4. Avoid cross seams.
- D. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.
- E. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

- F. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor covering.
- B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.
 - 1. Apply two coat(s).
- C. Cover floor coverings until Substantial Completion.

END OF SECTION 096516

SECTION 096816 - SHEET CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes woven carpet.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: For each color and texture required.
 - 1. Carpet: 12-inch- square Sample.
 - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- long Samples.
- C. Maintenance data.

1.3 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.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

1.6 WARRANTY

- A. Special Warranty for Carpet: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

1.7 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: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

PART 2 - PRODUCTS

2.1 WOVEN CARPET

- A. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Bigelow Commercial
 - 2. Lees Carpets
 - 3. Mannington Commercial
 - a. Color: As selected by Architect from manufacturer's full range.
 - b. Pattern: Match Architect's samples.
- B. Fiber Content: 80 percent wool; 20 percent nylon 6, 6
- C. Face Construction: Axminster.
- D. Pile Characteristic: Level-loop pile.
- E. Backing: Manufacturers standard.
- F. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- G. Performance Characteristics: As follows:
 - 1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
 - 2. Dry Breaking Strength: Not less than 100 lbf per ASTM D 2646.
 - 3. Resistance to Insects: Comply with AATCC 24.
 - 4. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
 - 5. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC 16, Option E.
 - 6. Electrostatic Propensity: Less than 3.5 kV per AATCC 134.
 - 7. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.
 - 1. VOC Limits: Provide adhesives with VOC content not more than 50g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
- C. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:
 - 1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- D. Install pattern parallel to walls and borders.

END OF SECTION 096816

SECTION 097700 – FIBERGLASS REINFORCED PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Prefinished FRP (Fiberglass Reinforced Plastic) wall panels for sanitary environments.

1.2 SUBMITTALS

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

1.3 WARRANTY

- A. Warranty: All products shall have standard Manufacturer warranty.

PART 2 - PRODUCTS

2.1 FRP Panels

- 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. Crane Composites
 2. Marlite
- B. Materials:
1. All sanitary wall panels shall be fiberglass reinforced plastic.
 2. Finish as selected by Architect.

2.2 Accessories:

- A. Trim Profiles: All trim specified shall be heavy weight extruded aluminum 6063-T5 alloy prefinished at the factory.
1. Inside corner.
 2. Outside corner.
 3. Division.
 4. Edge.

- B. Trim Finish:
 - 1. Factory oven-baked finish.
 - 2. Color: As selected by Architect.
- C. Outside Corner Guard: Stainless Steel.
- D. All PVC base molding shall be a rigid extruded PVC with integral color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Panels should be opened and allowed to acclimate for 48 hours prior to installation. Room temperature should be approximately 70 degree F.
- B. Install according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- C. Wipe down using a damp cloth and mild soap solution or cleaner. Refer to manufacturer's specific cleaning recommendations.

END OF SECTION 097700

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete masonry units (CMU).
 - 2. Steel.
 - 3. Gypsum board.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.
- C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

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

1.4 EXTRA MATERIALS

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

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content 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); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. 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).
2. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - o. Hexavalent chromium.
 - p. Isophorone.

- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

D. Colors: As selected by Architect from manufacturer's full range.

2.2 BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI #4.

- 1. VOC Content: E Range of E2.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

- 1. VOC Content: E Range of E1.
- 2. Environmental Performance Rating: EPR 1.

B. Interior Alkyd Primer/Sealer: MPI #45.

- 1. VOC Content: E Range of E1.

2.4 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

- 1. VOC Content: E Range of E1.

B. Quick-Drying Alkyd Metal Primer: MPI #76.

- 1. VOC Content: E Range of E1.

2.5 LATEX PAINTS

A. Interior Latex (Flat): MPI #53 (Gloss Level 1).

- 1. VOC Content: E Range of E1.
- 2. Environmental Performance Rating: EPR 0.5.

B. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 2.

2.6 ALKYD PAINTS

- A. Interior Alkyd (Flat): MPI #49 (Gloss Level 1).
 1. VOC Content: E Range of E1.
- B. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).
 1. VOC Content: E Range of E1.
 2. Environmental Performance Rating: EPR 1.

2.7 QUICK-DRYING ENAMELS

- A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
 1. VOC Content: E Range of E1.

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. Masonry (Clay and CMU): 12 percent.
 2. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- E. 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.
- F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
 - 1. Latex System: MPI INT 4.2A.
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex as selected by Architect.

2. Alkyd System: MPI INT 4.2C.
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd as selected by Architect.
 3. Alkyd Over Latex Sealer System: MPI INT 4.2N.
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Sealer Coat: Interior latex primer/sealer.
 - c. Intermediate Coat: Interior alkyd matching topcoat.
 - d. Topcoat: Interior alkyd as selected by Architect.
- B. Steel Substrates:
1. Quick-Drying Enamel System: MPI INT 5.1A.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Quick-drying enamel matching topcoat.
 - c. Topcoat: Quick-drying enamel as selected by Architect.
 2. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex as selected by Architect.
 3. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd as selected by Architect.
- C. Gypsum Board Substrates:
1. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex as selected by Architect.
 2. Alkyd Over Latex Primer System: MPI INT 9.2C.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd as selected by Architect.

END OF SECTION 099123

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Public-use washroom accessories.
 2. Underlavatory guards.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
1. Identify locations using room designations indicated.
 2. Identify products using designations indicated.
- C. Maintenance data.
- D. Warranty: Sample of special warranty.

1.3 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PUBLIC-USE WASHROOM ACCESSORIES

- 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. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.
 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 6. Tubular Specialties Manufacturing, Inc.

B. Toilet Tissue (Roll) Dispenser:

1. Description: Double-roll dispenser.
2. Mounting: Surface mounted.
3. Operation: Noncontrol delivery with standard spindle.
4. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

C. Paper Towel (Folded) Dispenser:

1. Mounting: Surface mounted.
2. Minimum Capacity: 400 C-fold or 525 multifold towels.
3. Material and Finish: Stainless steel, No. 4 finish (satin).
4. Lockset: Tumbler type.
5. Refill Indicators: Pierced slots at sides or front.

D. Combination Towel (Folded) Dispenser/Waste Receptacle:

1. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
2. Mounting: Surface mounted.
3. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
4. Minimum Waste-Receptacle Capacity: 4 gal..
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Liner: Reusable, vinyl waste-receptacle liner.
7. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

E. Liquid-Soap Dispenser:

1. Description: Designed for dispensing soap in liquid or lotion form.
2. Mounting: Horizontally oriented, surface mounted] [Vertically oriented, surface mounted.
3. Lockset: Tumbler type.
4. Refill Indicator: Window type.

F. Grab Bar:

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inchthick.
 - a. Finish: Smooth, No. 4 finish (satin).
3. Outside Diameter: 1-1/4 inches.
4. Configuration and Length: As indicated on Drawings.

G. Seat-Cover Dispenser:

1. Mounting: Surface mounted.
2. Minimum Capacity: 250 seat covers.
3. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
4. Lockset: Tumbler type.

H. Mirror Unit:

1. Frame: Stainless-steel angle, 0.05 inch thick.
 - a. Corners: Manufacturer's standard.
2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
3. Size: As indicated on Drawings.

2.2 UNDERLAVATORY GUARDS

- 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. Plumberex Specialty Products, Inc.
 2. Truebro by IPS Corporation.
- B. Underlavatory Guard:
1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 2. Material and Finish: Antimicrobial, molded plastic, white.

2.3 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

END OF SECTION 102800

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Submittals.
 - 2. Quality Assurance.
 - 3. Examination.
 - 4. Preparation.
 - 5. Repair/Restoration.
 - 6. Cleaning.
 - 7. Piping Installation.
 - 8. Sleeves.
 - 9. Escutcheons.
 - 10. Grout.
 - 11. Fire-suppression demolition.
 - 12. Supports and anchorages.
 - 13. Operation and Maintenance Manuals

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.
- B. Product Data:
 - 1. Manufacturer's catalog data for each manufactured item.
 - a. Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
 - b. Include name, address, and phone number of each supplier.
 - 2. Shop Drawings:
 - a. Schematic control diagrams for each separate fan system, heating system, control panel, etc. Each diagram shall show locations of all control and operational

components and devices. Mark correct operating settings for each control device on these diagrams.

- b. Diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches, and relays. Include drawings showing electrical power requirements and connection locations.
- c. Drawing of each temperature control panel identifying components in panels and their function.
- d. Other shop drawings required by Division 21 trade Sections.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Requirements of Regulatory Agencies:
 1. Perform work in accordance with applicable provisions of Plumbing Codes and Gas Ordinances applicable to Project. Provide materials and labor necessary to comply with rules, regulations and ordinances.
 2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
- D. Identification:
 1. Motor and equipment name plates as well as applicable UL and AGA labels shall be in place when Product is turned over to Owner.
 2. Materials shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.

1.5 OPERATION AND MAINTENANCE DATA

- A. Summary:
 1. This Section includes administrative and procedure requirements for preparing operation and maintenance manuals, including the following:
 - a. Operation manuals for systems, subsystems, and equipment.
 - b. Maintenance manuals for the care and maintenance of products, materials, finishes, systems and equipment.
- B. Submittals:
 1. Manual: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
 - a. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

PART 2 - PRODUCTS

2.1 EXAMINATION:

- A. Site Inspection:

1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which mechanical work is dependent for efficiency and report work that requires correction.
 2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- B. Drawings:
1. Plumbing and Mechanical Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
 2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing and Mechanical Drawings.
 3. Because of scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- C. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

2.2 PREPARATION:

- A. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.
- B. Changes Due to Equipment Selection:
1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings, if requested by Architect, showing proposed installations.
 2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
 3. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for proper operation of the system resulting from selection of equipment, including all required changes in affected trades.
 4. Be responsible for the proper location of roughing-in and connections provided under other Divisions.

2.3 REPAIR/RESTORATION:

- A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
 2. Surface finishes shall exactly match existing finishes of same materials.
- B. Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

2.4 CLEANING:

- A. Clean exposed piping, ductwork, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves.
- B. No more than one week before Final Inspection, flush out bearings and clean other lubricated surfaces with flushing oil. Provide best quality and grade of lubricant specified by Equipment Manufacturer.
- C. Replace filters in equipment for moving air with new filters of specified type no more than one week before Final Inspection.

2.5 PIPING INSTALLATION:

- A. Interface With Other Work:
 - 1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and see they are properly installed.
- B. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus.
 - 1. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
 - 2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings.
 - a. Arrange so as to facilitate removal of tube bundles.
 - b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
 - 1) Make connections of dissimilar metals with di-electric unions.
 - 2) Install valves and unions ahead of traps and strainers. Provide unions on both side of traps.
 - c. Do not use reducing bushings, street elbows, bull head tees, close nipples, or running traps.
 - d. Do not use reducing bushings, street elbows, bull head tees, close nipples, or running couplings.
 - e. Install piping systems so they may be easily drained. Provide drain valves at low points and manual air vents at high points in hot water heating and cooling water piping.
 - f. Install piping to insure noiseless circulation.
 - g. Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
 - 3. Do not install piping in shear walls.
- C. Properly support piping and make adequate provisions for expansion, contraction, slope and anchorage.
 - 1. Cut piping accurately for fabrication to measurements established at site. Remove burr and cutting slag from pipes.
 - 2. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
 - 3. Make changes in direction with proper fittings.
 - 4. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.

5. Supports for Horizontal Piping:
 - a. Support metal piping at 96 inches mm on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
 - b. Support thermoplastic pipe at 48 inches on center maximum.
 - c. Provide support at each elbow. Install additional support as required.
 6. Supports for Vertical Piping:
 - a. Place riser clamps at each floor or ceiling level.
 - b. Securely support clamps by structural members, which in turn are supported directly from building structure.
 - c. Provide clamps as necessary to brace pipe to wall.
 7. Insulate hangers for copper pipe from piping by means of at least two layers of Scott 33 plastic tape.
 8. Expansion of Thermoplastic Pipe:
 - a. Provide for expansion in every 30 feet of straight run.
 - b. Provide 12 inch offset below roof line in each vent line penetrating roof.
- D. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade. Seal sleeves with specified sealants.
1. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
 2. Sleeves through floors and foundation walls shall be watertight.
- E. Provide spring clamp plates (escutcheons) where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.

2.6 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.7 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.8 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.9 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

2.10 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.11 OPERATION AND MAINTENANCE MANUALS

- A. General:
 - 1. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
 - 2. Title Page: Enclose title page in transparent plastic sleeve. Include the following information.
 - a. Subject matter included in manual.
 - b. Name and address of Project.
 - c. Name and address of Owner.
 - d. Date of submittal.
 - e. Name, address, and telephone number of Contractor.
 - f. Name and address of Architect.
 - g. Cross-reference to related systems in other operation and maintenance manuals.

3. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 4. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
 - a. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2 by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 1) Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 - b. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - c. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 - d. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - 1) If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - 2) If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
 5. Include copies of approved shop drawings and copies of warranties required in individual Sections of Division 21.
- B. Operation Manuals
1. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
 2. Descriptions: Include the following:
 - a. Product name and model number.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 - h. Engineering data and tests.
 - i. Complete nomenclature and number of replacement parts.
 3. Operation Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
 4. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
 5. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.
- C. Product Maintenance Manual
1. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
 2. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address,

3. Product Information: Include the following, as applicable:
 - a. Product name and model number.
 - b. Manufacturer's name.
 - c. Color, pattern, and texture.
 - d. Material and chemical composition.
 - e. Reordering information for specially manufactured products.
 4. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
 5. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
 6. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- D. Systems and Equipment Maintenance Manual
1. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturer's maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
 2. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
 3. Manufacturer's Maintenance Documentation: Manufacturer's maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment.
 4. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions, and demonstration and training videotape if available, that detail essential maintenance procedures.
 5. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 6. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
 7. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
 8. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

- A. Refer to Division 01 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS:

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Through-Penetration Firestop Systems" for materials.
- O. Verify final equipment locations for roughing-in.
- P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

- C. Attach to substrates as required to support applied loads.

3.6 GROUTING

- A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.7 O & M MANUAL PREPREPARATION

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material and finish incorporated into the Work.
- B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- C. Manufacturer's Data: Where manuals contain manufacturer's standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data includes more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
- E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 210500

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Restraining braces.

1.2 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in ASCE, Section 9.4.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
 - 3. Category I:
 - a. Buildings and other structures that represent a low hazard to human life in the event of failure including, but not limited to: Agricultural facilities, certain temporary facilities, minor storage facilities.
 - 4. Category II:
 - a. All buildings and other structures except those listed in Categories I, III, and IV.
 - 5. Category III:
 - a. Buildings and other structures that represent a substantial hazard to human life in the event of failure including, but not limited to:
 - 1) Buildings and other structures where more than 300 people congregate in one area.
 - 2) Buildings and other structures with day care facilities with capacity greater than 150.
 - 3) Buildings and other structures with elementary school or secondary school facilities with capacity greater than 250.
 - 4) Buildings and other structures with a capacity greater than 500 for colleges or adult education facilities.
 - 5) Health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities.
 - 6) Jails and detention facilities.
 - 7) Power generating stations and other public utility facilities not included in Category IV.
 - b. Buildings and other structures not included in Category IV (including, but not limited to, facilities that manufacture, process, handle, store, use or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing sufficient quantities of hazardous materials to be dangerous to the public if released.
 - 6. Category IV:
 - a. Buildings and other structures designated as essential facilities including, but not limited to:

- 1) Hospitals and other health care facilities having surgery or emergency treatment facilities.
 - 2) Fire, rescue, ambulance, and police stations and emergency vehicle garages.
 - 3) Designated earthquake, hurricane, or other emergency shelters.
 - 4) Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response.
 - 5) Power generating stations and other public utility facilities required in an emergency.
 - 6) Ancillary structures (including, but not limited to, communication towers, fuel storage tanks, cooling towers, electrical substation structures, fire water storage tanks or other structures housing or supporting water, or other fire-suppression material or equipment) required for operation of Category IV structures during an emergency.
 - 7) Aviation control towers, air traffic control centers, and emergency aircraft hangers.
 - 8) Water storage facilities and pump structures required to maintain water pressure for fire suppression.
 - 9) Buildings and other structures having critical national defense functions.
- b. Buildings and other structures (including, but not limited to, facilities that manufacturer, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing extremely hazardous materials where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction.
 - c. Component Importance Factor: As per ASCE, Section 9.6.
 - d. Component Response Modification Factor: As per ASCE, Section 9.6.
 - e. Component Amplification Factor: As per ASCE, Section 9.6.
7. Design Spectral Response Acceleration at Short Periods (0.2 Second): As per ASCE, Section 9.4.
 8. Design Spectral Response Acceleration at 1-Second Period: As per ASCE, Section 9.4.

1.4 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent

testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- G. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127 and NFPA 13.

2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 3. Brace a change of direction longer than 12 feet.
- C. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- F. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid 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 and stainless-steel anchors for exterior applications.

3.2 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 21 Section "Fire-Suppression Piping" for piping flexible connections.

END OF SECTION 210548

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Sprinklers.

1.2 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.
- B. Revise existing wet pipe fire sprinkler system to accommodate new floor plan.

1.3 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. Office and Public Areas: Light Hazard.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - 4. Maximum Protection Area per Sprinkler: Per UL listing.
 - 5. Maximum Protection Area per Sprinkler:
 - a. Office and Public Spaces: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Electrical Equipment Rooms: 130 sq. ft.
 - d. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Qualification Data: For qualified Installer.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- F. Welding certificates.
- G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- H. Field quality-control reports.
- I. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
- E. Materials, devices and equipment shall be Underwriters Laboratory listed or Factory Mutual approved for use in fire protection systems.
- F. Designer shall be a Registered Fire Protection Engineer, or shall be certified as an Engineering Technician or Senior Engineering Technician (Level III or Level IV), National Institute for Certification in Engineering Technologies (NICET), Automatic Sprinkler System Layout.
- G. Installer shall be a state licensed fire sprinkler system contractor.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

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

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

- B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Uncoated, Steel Couplings: ASTM A 865, threaded.
- D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME 16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- J. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 SPRINKLER SPECIALTY PIPE FITTINGS

- A. Branch Outlet Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - 2. Standard: UL 213.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

5. Type: Mechanical-T and -cross fittings.
 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
 2. Standard: UL 1474.
 3. Pressure Rating: 250 psig minimum.
 4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
 5. Size: Same as connected piping.
 6. Length: Adjustable.
 7. Inlet and Outlet: Threaded.
- C. Flexible, Sprinkler Hose Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
 2. Standard: UL 1474.
 3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 4. Pressure Rating: 175 psig minimum.
 5. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFAC Inc.
 2. Globe Fire Sprinkler Corporation.
 3. Reliable Automatic Sprinkler Co., Inc.
 4. Tyco Fire & Building Products LP.
 5. Venus Fire Protection Ltd.
 6. Victaulic Company.
 7. Viking Corporation.
- B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
 3. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
 2. Nonresidential Applications: UL 199.
 3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:

1. Chrome plated.
 2. Bronze.
 3. Painted.
- E. Special Coatings:
1. Wax.
 2. Lead.
 3. Corrosion-resistant paint.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Plastic, white finish, one piece, flat.
 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 2. Standard: UL 199.
 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.6 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with set-screws.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.
- E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with concealed hinge and set-screw.
- F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge, set-screw or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.7 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set-screws.

2.8 GROUT

- A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink, and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- H. Fill sprinkler system piping with water.

3.2 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of (plus or minus 2") acoustical ceiling panels.
- B. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.4 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 - 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.5 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- G. Seal space outside of sleeves in concrete slabs and walls with grout.
- H. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- I. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.

- c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
- 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.6 IDENTIFICATION

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

3.7 FIELD QUALITY CONTROL

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

3.8 CLEANING

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

3.9 PIPING SCHEDULE

- A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- B. Wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.

3. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 4. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:
1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 3. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.10 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Flush sprinklers.
 3. Wall Mounting: Sidewall sprinklers.
 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
 5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 4. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Submittals.
 - 2. Quality Assurance
 - 3. Examination.
 - 4. Preparation.
 - 5. Repair/Restoration.
 - 6. Cleaning.
 - 7. Piping Installation.
 - 8. Dielectric fittings.
 - 9. Sleeves.
 - 10. Escutcheons.
 - 11. Grout.
 - 12. Plumbing demolition.
 - 13. Equipment installation requirements common to equipment sections.
 - 14. Supports and anchorages.
 - 15. Operation and Maintenance Manuals

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.
- B. Product Data:
 - 1. Manufacturer's catalog data for each manufactured item.
 - a. Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
 - b. Include name, address, and phone number of each supplier.

- C. Shop Drawings:
 - 1. Schematic control diagrams for each separate fan system, heating system, control panel, etc. Each diagram shall show locations of all control and operational components and devices. Mark correct operating settings for each control device on these diagrams.
 - 2. Diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches, and relays. Include drawings showing electrical power requirements and connection locations.
 - 3. Drawing of each temperature control panel identifying components in panels and their function.
 - 4. Other shop drawings required by Division 22 trade Sections.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- C. Requirements of Regulatory Agencies:
 - 1. Perform work in accordance with applicable provisions of Plumbing Codes and Gas Ordinances applicable to Project. Provide materials and labor necessary to comply with rules, regulations and ordinances.
 - 2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
- D. Identification:
 - 1. Motor and equipment name plates as well as applicable UL and AGA labels shall be in place when Product is turned over to Owner.
 - 2. Materials shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.

1.5 OPERATION AND MAINTENANCE DATA

- A. Summary:
 - 1. This Section includes administrative and procedure requirements for preparing operation and maintenance manuals, including the following:
 - a. Operation manuals for systems, subsystems, and equipment.
 - b. Maintenance manuals for the care and maintenance of products, materials, finishes, systems and equipment.
- B. Submittals:
 - 1. Manual: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
 - a. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

PART 2 - PRODUCTS

2.1 EXAMINATION:

- A. Site Inspection:

1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which mechanical work is dependent for efficiency and report work that requires correction.
2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

B. Drawings:

1. Plumbing and Mechanical Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing and Mechanical Drawings.
3. Because of scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

- C.** Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

2.2 PREPARATION:

- A.** Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.
- B.** Changes Due to Equipment Selection:
1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings, if requested by Architect, showing proposed installations.
 2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
 3. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for proper operation of the system resulting from selection of equipment, including all required changes in affected trades.
 4. Be responsible for the proper location of roughing-in and connections provided under other Divisions.

2.3 REPAIR/RESTORATION:

- A.** Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
 2. Surface finishes shall exactly match existing finishes of same materials.
- B.** Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

2.4 CLEANING:

- A. Clean exposed piping, ductwork, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves.
- B. No more than one week before Final Inspection, flush out bearings and clean other lubricated surfaces with flushing oil. Provide best quality and grade of lubricant specified by Equipment Manufacturer.
- C. Replace filters in equipment for moving air with new filters of specified type no more than one week before Final Inspection.

2.5 PIPING INSTALLATION:

- A. Interface With Other Work:
 - 1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and see they are properly installed.
- B. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus.
 - 1. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
 - 2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings.
 - a. Arrange so as to facilitate removal of tube bundles.
 - b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
 - 1) Make connections of dissimilar metals with di-electric unions.
 - 2) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
 - c. Do not use reducing bushings, street elbows, bull head tees, close nipples, or running traps.
 - d. Do not use reducing bushings, street elbows, bull head tees, close nipples, or running couplings.
 - e. Install piping systems so they may be easily drained. Provide drain valves at low points and manual air vents at high points in hot water heating and cooling water piping.
 - f. Install piping to insure noiseless circulation.
 - g. Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
 - 3. Do not install piping in shear walls.
- C. Properly support piping and make adequate provisions for expansion, contraction, slope and anchorage.
 - 1. Cut piping accurately for fabrication to measurements established at site. Remove burr and cutting slag from pipes.
 - 2. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
 - 3. Make changes in direction with proper fittings.

4. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
 5. Supports for Horizontal Piping:
 - a. Support metal piping at 96 inches mm on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
 - b. Support thermoplastic pipe at 48 inches on center maximum.
 - c. Provide support at each elbow. Install additional support as required.
 6. Supports for Vertical Piping:
 - a. Place riser clamps at each floor or ceiling level.
 - b. Securely support clamps by structural members, which in turn are supported directly from building structure.
 - c. Provide clamps as necessary to brace pipe to wall.
 7. Insulate hangers for copper pipe from piping by means of at least two layers of Scott 33 plastic tape.
 8. Expansion of Thermoplastic Pipe:
 - a. Provide for expansion in every 30 feet of straight run.
 - b. Provide 12 inch offset below roof line in each vent line penetrating roof.
 - c. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade. Seal sleeves with specified sealants.
 9. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
 10. Sleeves through floors and foundation walls shall be watertight.
- D. Provide spring clamp plates (escutcheons) where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.

2.6 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.7 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 1. ABS Piping: ASTM D 2235.
 2. CPVC Piping: ASTM F 493.

3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.8 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.9 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.10 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

2.11 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: **5000-psi**, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.12 OPERATION AND MAINTENANCE MANUALS

- A. General:
1. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
 2. Title Page: Enclose title page in transparent plastic sleeve. Include the following information.
 - a. Subject matter included in manual.
 - b. Name and address of Project.
 - c. Name and address of Owner.
 - d. Date of submittal.
 - e. Name, address, and telephone number of Contractor.
 - f. Name and address of Architect.
 - g. Cross-reference to related systems in other operation and maintenance manuals.
 3. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 4. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
 - a. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2 by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 1) Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 - b. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - c. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 - d. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - 1) If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - 2) If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
 5. Include copies of approved shop drawings and copies of warranties required in individual Sections of Division 22.
- B. Operation Manuals

1. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
 2. Descriptions: Include the following:
 - a. Product name and model number.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 - h. Engineering data and tests.
 - i. Complete nomenclature and number of replacement parts.
 3. Operation Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
 4. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
 5. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.
- C. Product Maintenance Manual
1. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
 2. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
 3. Product Information: Include the following, as applicable:
 - a. Product name and model number.
 - b. Manufacturer's name.
 - c. Color, pattern, and texture.
 - d. Material and chemical composition.
 - e. Reordering information for specially manufactured products.
 4. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
 5. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
 6. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- D. Systems and Equipment Maintenance Manual
1. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturer's maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
 2. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
 3. Manufacturer's Maintenance Documentation: Manufacturer's maintenance documentation including maintenance instructions, drawings and diagrams for

4. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions, and demonstration and training videotape if available, that detail essential maintenance procedures.
5. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
6. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
7. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
8. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Sections "Cutting and Patching" and Division 02 Section "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Through-Penetration Firestop Systems" for materials.
- O. Verify final equipment locations for roughing-in.
- P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping **NPS 2** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping **NPS 2-1/2** and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.9 O & M MANUAL PREPREPARATION

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material and finish incorporated into the Work.
- B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- C. Manufacturer's Data: Where manuals contain manufacturer's standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data includes more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.

- E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 220500

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.

- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.

- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

- D. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Handlever: For quarter-turn valves NPS 6 and smaller.

- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.

2.2 BRASS BALL VALVES

- A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.

j. Port: Full.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions, grooved joint couplings, or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
 - 2. Throttling Service: Ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, full port, brass or bronze with brass or bronze trim.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 21 Section "Fire-Suppression Piping" for fire-suppression piping.
- D. See Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Equipment supports.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
1. AAA Technology & Specialties Co., Inc.
 2. Bergen-Power Pipe Supports.
 3. B-Line Systems, Inc.; a division of Cooper Industries.
 4. Carpenter & Paterson, Inc.
 5. Empire Industries, Inc.
 6. ERICO/Michigan Hanger Co.
 7. Globe Pipe Hanger Products, Inc.
 8. Grinnell Corp.
 9. GS Metals Corp.
 10. National Pipe Hanger Corporation.
 11. PHD Manufacturing, Inc.
 12. PHS Industries, Inc.
 13. Piping Technology & Products, Inc.
 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. GS Metals Corp.
 4. Power-Strut Div.; Tyco International, Ltd.
 5. Thomas & Betts Corporation.
 6. Tolco Inc.
 7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): **750 lb.**
 - b. Medium (MSS Type 32): **1500 lb.**
 - c. Heavy (MSS Type 33): **3000 lb.**
 - 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2** and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. **NPS 1/4 to NPS 3-1/2: 12 inches** long and **0.048 inch** thick.
 - b. **NPS 4: 12 inches** long and **0.06 inch** thick.
 - c. **NPS 5 and NPS 6: 18 inches** long and **0.06 inch** thick.
 - d. **NPS 8 to NPS 14: 24 inches** long and **0.075 inch** thick.
 - e. **NPS 16 to NPS 24: 24 inches** long and **0.105 inch** thick.
 - 5. Pipes **NPS 8** and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of **2.0 mils**.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220548 - VIBRATION & SEISMIC CONTROLS FOR PLUMBING PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Housed spring mounts.
 - 5. Elastomeric hangers.
 - 6. Pipe riser resilient supports.
 - 7. Resilient pipe guides.
 - 8. Restraining braces and cables.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in ASCE, Section 9.4.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
 - 3. Category I:
 - a. Buildings and other structures that represent a low hazard to human life in the event of failure including, but not limited to: Agricultural facilities, certain temporary facilities, minor storage facilities.
 - 4. Category II:
 - a. All buildings and other structures except those listed in Categories I, III, and IV.
 - 5. Category III:
 - a. Buildings and other structures that represent a substantial hazard to human life in the event of failure including, but not limited to:
 - 1) Buildings and other structures where more than 300 people congregate in one area.
 - 2) Buildings and other structures with day care facilities with capacity greater than 150.
 - 3) Buildings and other structures with elementary school or secondary school facilities with capacity greater than 250.
 - 4) Buildings and other structures with a capacity greater than 500 for colleges or adult education facilities.
 - 5) Health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities.
 - 6) Jails and detention facilities.
 - 7) Power generating stations and other public utility facilities not included in Category IV.
 - b. Buildings and other structures not included in Category IV (including, but not limited to, facilities that manufacturer, process, handle, store, use or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing sufficient quantities of hazardous materials to be dangerous to the public if released.
 - 6. Category IV:
 - a. Buildings and other structures designated as essential facilities including, but not limited to:
 - 1) Hospitals and other health care facilities having surgery or emergency treatment facilities.
 - 2) Fire, rescue, ambulance, and police stations and emergency vehicle garages.

- 3) Designated earthquake, hurricane, or other emergency shelters.
 - 4) Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response.
 - 5) Power generating stations and other public utility facilities required in an emergency.
 - 6) Ancillary structures (including, but not limited to, communication towers, fuel storage tanks, cooling towers, electrical substation structures, fire water storage tanks or other structures housing or supporting water, or other fire-suppression material or equipment) required for operation of Category IV structures during an emergency.
 - 7) Aviation control towers, air traffic control centers, and emergency aircraft hangers.
 - 8) Water storage facilities and pump structures required to maintain water pressure for fire suppression.
 - 9) Buildings and other structures having critical national defense functions.
- b. Buildings and other structures (including, but not limited to, facilities that manufacturer, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing extremely hazardous materials where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction.
 - c. Component Importance Factor: As per ASCE, Section 9.6.
 - d. Component Response Modification Factor: As per ASCE, Section 9.6.
 - e. Component Amplification Factor: As per ASCE, Section 9.6.
7. Design Spectral Response Acceleration at Short Periods (0.2 Second): As per ASCE, Section 9.4
 8. Design Spectral Response Acceleration at 1-Second Period: As per ASCE, Section 9.4.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Qualification Data: For professional engineer.
- E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent

testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
 2. Amber/Booth Company, Inc.
 3. California Dynamics Corporation.
 4. Isolation Technology, Inc.
 5. Kinetics Noise Control.
 6. Mason Industries.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.
 9. Vibration Mountings & Controls, Inc.
- B. **Pads:** Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. **Resilient Material:** Oil- and water-resistant neoprene.
- C. **Mounts:** Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. **Materials:** Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. **Neoprene:** Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. **Restrained Mounts:** All-directional mountings with seismic restraint.
1. **Materials:** Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. **Neoprene:** Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. **Elastomeric Hangers:** Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- F. **Pipe Riser Resilient Support:** All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- G. **Resilient Pipe Guides:** Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
 - 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- G. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid 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 and stainless steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe labels.
 - 2. Ceiling markers.

1.2 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.2 CEILING MARKERS

- A. Ceiling Markers: 1/2-inch diameter self adhesive color coded label for marking location of valves, dampers, controllers, etc. above acoustical ceiling tiles.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Domestic Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

3.3 CEILING MARKERS

- A. Install ceiling markers on acoustical tile ceilings T-bar marking the location of valves, dampers, controllers, etc. and other items used for or requiring maintenance.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
 - c. Polyolefin.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Sealants.
 - 6. Factory-applied jackets.
 - 7. Tapes.
- B. Related Sections include the following:
 - 1. Division 23 Section "HVAC Insulation."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- D. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.

- c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- E. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- F. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. RBX Corporation; Therma-cell.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 4. Solids Content: 63 percent by volume and 73 percent by weight.
 5. Color: White.

2.4 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 100 to plus 300 deg F.
 5. Color: White or gray.
- B. ASJ Flashing Sealants PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fason 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.7 POLYOLEFIN INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of polyolefin pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FINISHES

- A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Drainage piping located in crawl spaces.
 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold, Hot and Recirculated Hot Water: Insulation shall be the following:
 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Cold, Hot and Recirculated Hot Water Underground or in Block Wall: Insulation shall be the following:
 1. Flexible Elastomeric: 3/4 inch thick.
 2. Polyolefin: 3/4 inch thick.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
 - 3. Flexible connectors.
 - 4. Escutcheons.
 - 5. Sleeves and sleeve seals.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable Victaulic style or series number.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

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

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

- c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- 6. Grooved-End Copper Fittings: ASTM B 75 or ASTM B 152 and ASME B16.22, copper tube or ASTM B 584 and ASME B16.18 bronze sand castings. Fittings shall be manufactured to copper tubing sized dimensions (flaring of tube and fitting ends to IPS dimensions is not permitted).
 - a. Grooved Mechanical Couplings: Copper-tube dimensions and design similar to ASME/AWWA C606. Include ASTM A536 ductile iron housing sections cast with offsetting, angle-pattern bolt pads, synthetic rubber gasket of a FlushSeal pressure-responsive design, Grade E for domestic water systems. Zinc-plated carbon steel bolts and nuts. Victaulic Style 606.
 - b. Flange Adapters: Copper-tube dimensions. ASTM A536 ductile iron, CL 150 bolt hole pattern, complete with a pressure responsive synthetic rubber gasket. Grade E for domestic water systems. Victaulic Style 641.
 - c. Gaskets used on domestic water systems shall be UL classified in accordance with ASME/NSF 61 for use on hot (+180 deg F) and cold (+86 deg F) domestic water systems.
 - d. Victaulic grooved joint couplings, fittings, flange adapters and valves shall be sized to copper-tube dimensions. Flaring of tube and fitting ends to IPS dimensions is not permitted.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:

1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.

- C. Dielectric Flanges:
 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

- D. Dielectric-Flange Kits:
 1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

- E. Dielectric Couplings:
 1. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.

- F. Dielectric Nipples:
 1. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.7 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.8 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.9 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install domestic water piping level without pitch and plumb.
- C. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install piping to permit valve servicing.

- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- M. Trap primer supply piping shall be the same as under-building-slab, domestic water piping.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

3.9 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
- C. Escutcheons for Existing Piping:
 - 1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - 2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
 - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
 - 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
 - 5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish.
 - 6. Bare Piping in Equipment Rooms: Split plate, stamped steel with set screw or spring clips.
 - 7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.10 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. Seal space outside of sleeves in concrete slabs and walls with grout.
- H. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- I. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

- Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. PVC pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
- J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.11 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.13 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.14 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Grooved joints may be used on aboveground grooved-end piping.
- D. Fitting Option: Vic Press 304 pipe, fittings, couplings and valves may be used in lieu of soldered copper or threaded MI fittings on 2" and smaller aboveground piping.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Hard copper tube, ASTM B 88, Type L; copper push-on-joint fittings; and push-on joints.

3.15 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller.
 2. Throttling Duty: Use ball valves for piping NPS 2 and smaller.

3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Balancing valves.
 - 2. Temperature-actuated water mixing valves.
 - 3. Water hammer arresters.
 - 4. Trap-seal devices.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 BALANCING VALVES

- A. Memory-Stop Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump
 - c. Conbraco Industries, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Div.
 - g. Hammond Valve.
 - h. Itt Industries
 - i. Milwaukee Valve Company.
 - j. NIBCO INC.
 - k. Red-White Valve Corp.
 - l. Taco
 - 2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 - 3. Pressure Rating: 400-psig minimum CWP.
 - 4. Size: NPS 2 or smaller.

5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.2 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Leonard Valve Company.
 - g. Powers; a Watts Industries Co.
 - h. Symmons Industries, Inc.
 - i. Taco, Inc.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F.
9. Valve Finish: Chrome plated for exposed, rough bronze for concealed.

2.3 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.4 TRAP-SEAL DEVICES

A. Supply-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.

- b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
- B. Trap Seal Valve:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Trap Guard by Proset Inc.
 2. Trap seal device may be substituted for trap primer with approval of building official and engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing " for piping joining materials, joint construction, and basic installation requirements.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
- D. Install water hammer arresters in water piping according to PDI-WH 201.
- E. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- F. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 1. Test each reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow of balancing valves.

- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.
- C. Domestic cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer. Non-domestic cast iron pipe and fittings shall be certified to ISO 9001:2000 Standards. Contractor shall provide appropriate "Material Test Reports" for cast iron pipe and fittings or compliance to ASTM A 888 or CISPI 301, hubless pipe and fittings; or ASTM A 74, hub and spigot.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.
- B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- C. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method.
 - 1. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
 - 2. Pressure Fittings:

- a. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - b. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - c. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
 - d. Cast-Iron Flanges: ASME B16.1, Class 125.
 - e. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
- D. Cellular-Core PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil, waste, and vent piping NPS 6 and smaller shall be the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 2. Steel pipe, drainage fittings, and threaded joints.
- D. Underground, soil, waste, and vent piping NPS 6 and smaller shall be the following:
 1. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- F. Cleanouts shall be installed at each change of direction of the building drain or horizontal waste or soil lines greater than 45 degrees. Where more than one change of direction occurs in a run

of piping, only one cleanout shall be required for each 40 feet of developed length of the drainage piping.

- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 4 and smaller; 1 percent downward in direction of flow for piping NPS 6 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- K. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
 - 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 2. Prepare reports for tests and required corrective action.

3.7 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.8 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 1. Cleanouts.
 2. Floor drains.
 3. Roof flashing assemblies.
 4. Miscellaneous sanitary drainage piping specialties.
 5. Flashing materials.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 3. Size: Same as connected drainage piping
 4. Body Material: As required to match connected piping.
 5. Closure: Countersunk brass plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Floor Cleanouts:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
 3. Size: Same as connected branch.
 4. Type: Adjustable housing.

5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Extra Heavy Duty.
13. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: As required to match connected piping.
5. Closure: Drilled-and-threaded, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide J.R. Smith Model 2010 or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain, light duty.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Not required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top of Strainer Material: Stainless steel.
13. Top of Body and Strainer Finish: Stainless steel.
14. Top Shape: Round.
15. Top Loading Classification: Light duty.
16. Funnel: Not required.
17. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
18. Trap Material: Cast iron.

19. Trap Pattern: Deep-seal P-trap.
20. Trap Features: Trap-seal primer valve drain connection.

2.3 AIR-ADMITTANCE VALVES

- A. Fixture Air-Admittance Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ayrlett, LLC.
 - b. Durgo, Inc.
 - c. Oatey
 - d. ProSet Systems Inc.
 - e. RectorSeal.
 - f. Studor, Inc.
 2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
 3. Housing: Plastic.
 4. Operation: Mechanical sealing diaphragm.
 5. Size: Same as connected fixture or branch vent piping.
- B. Wall Box:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durgo, Inc.
 - b. Oatey.
 - c. RectorSeal.
 - d. Studor, Inc.
 2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
 3. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.4 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
1. Open-Top Vent Cap: Without cap.
 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Deep-Seal Traps:
1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- B. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top

- of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.
- C. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- D. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 2. Size: Same as connected stack vent or vent stack.

2.6 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.7 OUTLET BOXES

- A. Manufacturers:
1. Acorn Engineering Company.
 2. Gray, Guy Manufacturing Co., Inc.
 3. IPS Corporation.
 4. LSP Products Group.
 5. Oatey.
 6. Plastic Oddities, Inc.
 7. Symmons Industries, Inc.
 8. Zurn Industries, Inc.; Jonespec Div.
- B. General: Recessed-mounting outlet boxes with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- C. Clothes Washer Outlet Boxes With hot- and cold-water hose connections, drain, and the following:
1. Box and Faceplate: Steel.
 2. Shutoff Fitting(s): Two hose bibs.
 3. Supply Fittings: Two NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
 4. Drain: NPS 2 standpipe, P-trap, and direct waste connection to drainage piping.
 5. Inlet Hoses: Two ASTM D3571, 60-inch-long, rubber household clothes washer inlet hoses with female hose-thread couplings.

6. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Assemble open drain fittings and install with top of hub 1 inch above floor.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

- L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- M. Install vent caps on each vent pipe passing through roof.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- O. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Water closets.
 - 2. Lavatories.
 - 3. Sinks.
 - 4. Faucets for lavatories and sinks.
 - 5. Toilet seats.
 - 6. Protective shielding guards.
 - 7. Fixture supports.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. Sinks used in commercial food preparation facilities shall bear NSF seal.

- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 4. Stainless-Steel Sinks: ASME A112.19.3.
 - 5. Vitreous-China Fixtures: ASME A112.19.2M.
 - 6. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Faucets: ASME A112.18.1.
 - 2. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 3. NSF Potable-Water Materials: NSF 61.
 - 4. Pipe Threads: ASME B1.20.1.
 - 5. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 6. Supply Fittings: ASME A112.18.1.
 - 7. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.
 - 3. Brass Waste Fittings: ASME A112.18.2.
 - 4. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Off-Floor Fixture Supports: ASME A112.6.1M.
 - 2. Pipe Threads: ASME B1.20.1.
 - 3. Plastic Toilet Seats: ANSI Z124.5.
 - 4. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 WATER CLOSETS:

- A. Water Closets – WC-1:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler Cimarron Comfort Height Elongated K-3496 or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C./Fiat Products.
 - d. Eljer.
 - e. Gerber Plumbing Fixtures LLC.
 - f. Kohler Co.
 - g. TOTO USA, Inc.
 - 2. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer tank operation.
 - 3. Style: Close coupled.
 - a. Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.

- b. Height: Accessible.
 - c. Design Consumption: 1.6 gal./flush.
 - d. Tank: Flushometer-tank type with trim and gravity tank. Include cover.
 - e. Trip Mechanism: Lever-handle actuator.
 - f. Color: White.
4. Supply: NPS 3/8 chrome-plated brass or copper with wheel-handle stop.

2.2 LAVATORIES

- A. Lavatories, Wall Hung, L-1:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler Greenwich Model K-2031 or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Eljer.
 - c. Kohler Co.
 - d. Briggs Plumbing Products, Inc.
 - e. Crane Plumbing, L.L.C./Fiat Products.
 - f. Eljer.
 - g. Gerber Plumbing Fixtures LLC.
 - h. TOTO USA, Inc.
 - 2. Description: Accessible, wall-mounting, vitreous-china fixture.
 - a. Type: Shelf back.
 - b. Size: 20 by 18 inches rectangular.
 - c. Faucet Hole Punching: Three holes, 2-inch centers.
 - d. Faucet Hole Location: Top.
 - e. Pedestal: Not required.
 - f. Color: White.
 - g. Faucet: Required.
 - h. Supplies: NPS 3/8 chrome-plated copper with stops.
 - i. Drain: Grid.
 - 1) Location: Near back of bowl.
 - j. Drain Piping: NPS 1-1/4 chrome-plated, brass P-trap; NPS 1-1/4, 0.58 inch, thick tubular brass waste to wall; and wall escutcheon.
 - k. Hair Interceptor: Not required.
 - l. Protective Shielding Guard(s): Required.
 - m. Fixture Support: Lavatory.
 - n. Thermostatic Mixing Valve: Required.

2.3 SINKS

- A. Sink, 1-compartment, S-1, 2:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Model CHS-1716-C, or a comparable product by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Company.
 - 2. Description: One-bowl, commercial accessible, wall-mounting, type 304, stainless-steel, hand wash sink.
 - a. Overall Dimensions: 17 x 16 inches.
 - b. Metal Thickness: 0.050 inch.
 - c. Bowl:
 - 1) Dimensions: 12 x 9 x 6 inches.
 - 2) Drain: 3-1/2-inch crumb cup.
 - a) Location: Centered in bowl.
 - d. Sink Faucet: Included (1).
 - e. Supplies: NPS 1/2 chrome-plated copper with stops.

- f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap, 0.058 inch-thick tubular brass waste to wall; and wall escutcheon(s).
 - g. Thermostatic Mixing Valve: Required.
- B. Sink, 1-compartment, S-3:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay LR-2219-12 or a comparable product by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Company.
 - 2. Description: One-bowl, commercial, counter-mounting, type 302, stainless-steel laundry sink.
 - a. Overall Dimensions: 22 x 19 inches.
 - b. Metal Thickness: 0.050 inch.
 - c. Bowl:
 - 1) Dimensions: 18 x 14 x 12 inches.
 - 2) Drain: 3-1/2-inch crumb cup.
 - a) Location: Centered in bowl.
 - d. Sink Faucet: Required (1).
 - e. Supplies: NPS 1/2 chrome-plated copper with stops.
 - f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 0.058-inch-thick tubular brass waste to wall and wall escutcheon(s).
- C. Sink, 1-Compartment, S-4:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Belvedere Model 2800:
 - 2. Description: One-bowl, commercial, wall-mounting, acrylic hair wash sink.
 - a. Overall Dimensions: 19 x 19 inches.
 - b. Sink Faucet: Required (1).
 - c. Supplies: NPS 1/2 chrome-plated copper with stops.
 - d. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap, 0.058 inch-thick tubular brass waste to wall; and wall escutcheon(s).
 - e. Air-Gap Fitting: Required.

2.4 LAVATORY FAUCETS

- A. Lavatory Faucets – Accessible:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Moen Model 8460 or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Bradley Corporation.
 - c. Chicago Faucets.
 - d. Delta Faucet Company.
 - e. Eljer.
 - f. Elkay Manufacturing Co.
 - g. Fisher Manufacturing Co.
 - h. Grohe America, Inc.
 - i. Just Manufacturing Company.
 - j. Kohler Co.
 - k. Moen, Inc.
 - l. Speakman Company.
 - m. T & S Brass and Bronze Works, Inc.
 - n. Zurn Plumbing Products Group; Commercial Brass Operation.
 - 2. Description: Single-control mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: General-duty, copper or brass underbody with brass cover plate.

- b. Finish: Polished chrome plate.
- c. Maximum Flow Rate: 0.5 gpm.
- d. Maximum Flow: 0.25 gal.
- e. Centers: 4 inches.
- f. Mounting: Deck, exposed.
- g. Valve Handle(s): Lever.
- h. Inlet(s): NPS 3/8 tubing, with NPS 1/2 male adaptor.
- i. Spout: Rigid type.
- j. Spout Outlet: Aerator.
- k. Operation: Noncompression, manual.
- l. Drain: Grid.

2.5 SINK FAUCETS

A. Sink Faucets – Hair Wash:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Belvedere Model 522.
- 2. Description: Hair wash faucet with spray. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: General-duty, copper or brass underbody with brass cover plate.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Single control.
 - e. Backflow Protection Device for Hose Outlet: Deck mounted type.
 - f. Mounting: Deck.
 - g. Inlet(s): NPS 3/8 tubing with NPS 1/2 male adapter.
 - h. Supply: WHIZ™ spray with 42" long hose.
 - i. Operation: Noncompression, manual.
 - j. Drain: Grid with hair trap.

B. Sink-Faucets – Laundry:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Moen Model 8123/S0002 or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Bradley Corporation.
 - c. Chicago Faucets.
 - d. Delta Faucet Company.
 - e. Eljer.
 - f. Elkay Manufacturing Co.
 - g. Fisher Manufacturing Co.
 - h. Grohe America, Inc.
 - i. Just Manufacturing Company
 - j. Kohler Co.
 - k. Moen, Inc.
 - l. Speakman Company.
 - m. T & S Brass and Bronze Works, Inc.
 - n. Zurn Plumbing Products Group; Commercial Brass Operation.
- 2. Description: Gooseneck sink faucet. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: General-duty, copper or brass underbody with brass cover plate.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate; 2.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Two-lever handle.
 - e. Backflow Protection Device for Hose Outlet: Not required.
 - f. Backflow Protection Device for Side Spray: Not required.

- g. Centers: 8 inches.
- h. Mounting: Deck.
- i. Handle(s): Wrist blade, 4 inches.
- j. Inlet(s): NPS 3/8 tubing with NPS 1/2 male adapter.
- k. Spout Type: Rigid gooseneck.
- l. Spout Outlet: Aerator.
- m. Vacuum Breaker: Not required.
- n. Operation: Compression, manual.
- o. Drain: Grid.

2.6 TOILET SEATS

A. Toilet Seats:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bemis Model 1655-C or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Bemis Manufacturing Company.
 - c. Church Seats.
 - d. Eljer.
 - e. Kohler Co.
 - f. Olsonite Corp.
 - g. Sanderson Plumbing Products, Inc.; Beneke Div.
 - h. Sperzel.

2.7 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
- 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.8 FIXTURE SUPPORTS

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

- 1. Josam Company.
- 2. MIFAB Manufacturing Inc.
- 3. Smith, Jay R. Mfg. Co.
- 4. Tyler Pipe; Wade Div.
- 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
- 6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Lavatory Supports:

- 1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
- 2. Accessible-Fixture Support: Include rectangular steel uprights.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- K. Install toilet seats on water closets.
- L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- P. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

- Q. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 22 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 22 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Submittals:
 - 2. Quality Assurance:
 - 3. Examination.
 - 4. Preparation.
 - 5. Repair/Restoration.
 - 6. Cleaning.
 - 7. Piping Installation.
 - 8. Dielectric fittings.
 - 9. Sleeves.
 - 10. Escutcheons.
 - 11. Grout.
 - 12. HVAC demolition.
 - 13. Equipment installation requirements common to equipment sections.
 - 14. Supports and anchorages.
 - 15. Operation and Maintenance Manuals.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.
- B. Product Data:
 - 1. Manufacturer's catalog data for each manufactured item.
 - a. Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
 - b. Include name, address, and phone number of each supplier.
- C. Shop Drawings:

1. Schematic control diagrams for each separate fan system, heating system, control panel, etc. Each diagram shall show locations of all control and operational components and devices. Mark correct operating settings for each control device on these diagrams.
2. Diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches, and relays. Include drawings showing electrical power requirements and connection locations.
3. Drawing of each temperature control panel identifying components in panels and their function.
 - a. Other shop drawings required by Division 23 trade Sections.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
 1. The contractor shall verify motor voltages with the electrical drawings before ordering motorized equipment and controls. Motor name plate voltage shall be NEMA standard 200 volt for 208 volt three phase system and shall be NEMA Standard 230 volt for 240 volt three phase or single phase system. Starter heaters installed shall be coordinated with the name plate data.
- D. Requirements of Regulatory Agencies:
 1. Perform work in accordance with applicable provisions of Plumbing Codes and Gas Ordinances applicable to Project. Provide materials and labor necessary to comply with rules, regulations and ordinances.
 2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
- E. Identification:
 1. Motor and equipment name plates as well as applicable UL and AGA labels shall be in place when Product is turned over to Owner.
 2. Materials shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.

1.5 OPERATION AND MAINTENANCE DATA

- A. Summary:
 1. This Section includes administrative and procedure requirements for preparing operation and maintenance manuals, including the following:
 - a. Operation manuals for systems, subsystems, and equipment.
 - b. Maintenance manuals for the care and maintenance of products, materials, finishes, systems and equipment.
- B. Submittals:

1. Manual: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
 - a. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

PART 2 - PRODUCTS

2.1 EXAMINATION:

- A. Site Inspection:
 1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which mechanical work is dependent for efficiency and report work that requires correction.
 2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- B. Drawings:
 1. Plumbing and Mechanical Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
 2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing and Mechanical Drawings.
 3. Because of scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- C. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

2.2 PREPARATION:

- A. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.
- B. Changes Due to Equipment Selection:
 1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings, if requested by Architect, showing proposed installations.
 2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
 3. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for proper operation of the system resulting from selection of equipment, including all required changes in affected trades.
 4. Be responsible for the proper location of roughing-in and connections provided under other Divisions.

2.3 REPAIR/RESTORATION:

- A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
 - 1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
 - 2. Surface finishes shall exactly match existing finishes of same materials.
- B. Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

2.4 CLEANING:

- A. Clean exposed piping, ductwork, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves.
- B. No more than one week before Final Inspection, flush out bearings and clean other lubricated surfaces with flushing oil. Provide best quality and grade of lubricant specified by Equipment Manufacturer.
- C. Replace filters in equipment for moving air with new filters of specified type no more than one week before Final Inspection.

2.5 PIPING INSTALLATION:

- A. Interface With Other Work:
 - 1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and see they are properly installed.
- B. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus.
 - 1. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
 - 2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings.
 - a. Arrange so as to facilitate removal of tube bundles.
 - b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
 - 1) Make connections of dissimilar metals with di-electric unions.
 - 2) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
 - c. Do not use reducing bushings, street elbows, bull head tees, close nipples, or running traps.
 - d. Do not use reducing bushings, street elbows, bull head tees, close nipples, or running couplings.
 - e. Install piping systems so they may be easily drained. Provide drain valves at low points and manual air vents at high points in hot water heating and cooling water piping.
 - f. Install piping to insure noiseless circulation.
 - g. Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
 - 3. Do not install piping in shear walls.

- C. Properly support piping and make adequate provisions for expansion, contraction, slope and anchorage.
 - 1. Cut piping accurately for fabrication to measurements established at site. Remove burr and cutting slag from pipes.
 - 2. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
 - 3. Make changes in direction with proper fittings.
 - 4. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
 - 5. Supports for Horizontal Piping:
 - a. Support metal piping at 96 inches mm on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
 - b. Support thermoplastic pipe at 48 inches on center maximum.
 - c. Provide support at each elbow. Install additional support as required.
 - 6. Supports for Vertical Piping:
 - a. Place riser clamps at each floor or ceiling level.
 - b. Securely support clamps by structural members, which in turn are supported directly from building structure.
 - c. Provide clamps as necessary to brace pipe to wall.
 - 7. Insulate hangers for copper pipe from piping by means of at least two layers of Scott 33 plastic tape.
 - 8. Expansion of Thermoplastic Pipe:
 - a. Provide for expansion in every 30 feet of straight run.
 - b. Provide 12 inch offset below roof line in each vent line penetrating roof.
- D. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade. Seal sleeves with specified sealants.
 - 1. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
 - 2. Sleeves through floors and foundation walls shall be watertight.
- E. Provide spring clamp plates (escutcheons) where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.

2.6 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.7 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.8 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for **250-psig** minimum working pressure at **180 deg F**.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for **150- or 300-psig** minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and **300-psig** minimum working pressure at **225 deg F**.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and **300-psig** minimum working pressure at **225 deg F**.

2.9 SLEEVES

- A. Galvanized-Steel Sheet: **0.0239-inch** minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.10 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

2.11 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.12 OPERATION AND MAINTENANCE MANUALS

- A. General:
 - 1. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
 - 2. Title Page: Enclose title page in transparent plastic sleeve. Include the following information.
 - a. Subject matter included in manual.
 - b. Name and address of Project.
 - c. Name and address of Owner.
 - d. Date of submittal.
 - e. Name, address, and telephone number of Contractor.
 - f. Name and address of Architect.
 - g. Cross-reference to related systems in other operation and maintenance manuals.
 - 3. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 4. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
 - a. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2 by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 1) Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 - b. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - c. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 - d. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - 1) If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - 2) If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate

- locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
5. Include copies of approved shop drawings and copies of warranties required in individual Sections of Division 23.
- B. Operation Manuals
1. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
 2. Descriptions: Include the following:
 - a. Product name and model number.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 - h. Engineering data and tests.
 - i. Complete nomenclature and number of replacement parts.
 3. Operation Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
 4. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
 5. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.
- C. Product Maintenance Manual
1. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
 2. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
 3. Product Information: Include the following, as applicable:
 - a. Product name and model number.
 - b. Manufacturer's name.
 - c. Color, pattern, and texture.
 - d. Material and chemical composition.
 - e. Reordering information for specially manufactured products.
 4. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
 5. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
 6. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- D. Systems and Equipment Maintenance Manual
1. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturer's maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
 2. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents.

For each product, list name, address, and telephone number of installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

3. **Manufacturer's Maintenance Documentation:** Manufacturer's maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment.
4. **Maintenance Procedures:** Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions, and demonstration and training videotape if available, that detail essential maintenance procedures.
5. **Maintenance and Service Schedules:** Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
6. **Spare Parts List and Source Information:** Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
7. **Maintenance Service Contracts:** Include copies of maintenance agreements with name and telephone number of service agent.
8. **Warranties and Bonds:** Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 1. **Piping to Be Removed:** Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. **Piping to Be Abandoned in Place:** Drain piping and cap or plug piping with same or compatible piping material.
 3. **Ducts to Be Removed:** Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 4. **Ducts to Be Abandoned in Place:** Cap or plug ducts with same or compatible ductwork material.
 5. **Equipment to Be Removed:** Disconnect and cap services and remove equipment.
 6. **Equipment to Be Removed and Reinstalled:** Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. **Equipment to Be Removed and Salvaged:** Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction

loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- O. Verify final equipment locations for roughing-in.
- P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping **NPS 2** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping **NPS 2-1/2** and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.9 O & M MANUAL PREPREPARATION

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material and finish incorporated into the Work.
- B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- C. Manufacturer's Data: Where manuals contain manufacturer's standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data includes more than one item in a

tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

- D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
- E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 1. Motor controllers.
 2. Torque, speed, and horsepower requirements of the load.
 3. Ratings and characteristics of supply circuit and required control sequence.
 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of **3300 feet** above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.

- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.

- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

- D. Motors 1/20 HP and Smaller: Shaded-pole type.

- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.
- B. Related Sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handlever: For quarter-turn valves NPS 6 and smaller.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- F. Valve-End Connections:
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - 2. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.

- c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions, grooved joint couplings, or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
 - 2. Throttling Service: Ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.5 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, full port, bronze with bronze trim.
 - 3. Ball Valves, NPS 2 and Smaller: Two-piece, 300-psig CWP rating, brass alloy.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 21 Section "Fire-Suppression Piping" for fire protection piping.
- D. See Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
- E. See Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Equipment supports.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.
 - 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.

5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
1. Carpenter & Paterson, Inc.
 2. ERICO/Michigan Hanger Co.
 3. PHS Industries, Inc.
 4. Pipe Shields, Inc.
 5. Rilco Manufacturing Company, Inc.
 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 - 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:

- a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
- b. NPS 4: 12 inches long and 0.06 inch thick.
- c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
- d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Restraining braces and cables.

1.2 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: As per AHJ.
 - 2. Building Classification Category: III.
 - 3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

- B. Seismic-Restraint Loading:
 - 1. Site Class as Defined in ASCE, Section 9.6.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
 - 3. Category I:
 - a. Buildings and other structures that represent a low hazard to human life in the event of failure including, but not limited to: Agricultural facilities, certain temporary facilities, minor storage facilities.
 - 4. Category II:
 - a. All buildings and other structures except those listed in Categories I, III, and IV.
 - 5. Category III:
 - a. Buildings and other structures that represent a substantial hazard to human life in the event of failure including, but not limited to:
 - 1) Buildings and other structures where more than 300 people congregate in one area.
 - 2) Buildings and other structures with day care facilities with capacity greater than 150.
 - 3) Buildings and other structures with elementary school or secondary school facilities with capacity greater than 250.
 - 4) Buildings and other structures with a capacity greater than 500 for colleges or adult education facilities.
 - 5) Health care facilities with a capacity of 50 or more resident patients but not having surgery or emergency treatment facilities.
 - 6) Jails and detention facilities.
 - 7) Power generating stations and other public utility facilities not included in Category IV.
 - b. Buildings and other structures not included in Category IV (including, but not limited to, facilities that manufacturer, process, handle, store, use or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or

- explosives) containing sufficient quantities of hazardous materials to be dangerous to the public if released.
6. Category IV:
 - a. Buildings and other structures designated as essential facilities including, but not limited to:
 - 1) Hospitals and other health care facilities having surgery or emergency treatment facilities.
 - 2) Fire, rescue, ambulance, and police stations and emergency vehicle garages.
 - 3) Designated earthquake, hurricane, or other emergency shelters.
 - 4) Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response.
 - 5) Power generating stations and other public utility facilities required in an emergency.
 - 6) Ancillary structures (including, but not limited to, communication towers, fuel storage tanks, cooling towers, electrical substation structures, fire water storage tanks or other structures housing or supporting water, or other fire-suppression material or equipment) required for operation of Category IV structures during an emergency.
 - 7) Aviation control towers, air traffic control centers, and emergency aircraft hangers.
 - 8) Water storage facilities and pump structures required to maintain water pressure for fire suppression.
 - 9) Buildings and other structures having critical national defense functions.
 - b. Buildings and other structures (including, but not limited to, facilities that manufacturer, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing extremely hazardous materials where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction.
 - c. Component Importance Factor: As per ASCE, Section 9.4.
 - d. Component Response Modification Factor: As per ASCE, Section 9.4.
 - e. Component Amplification Factor: As per ASCE, Section 9.4.
 7. Design Spectral Response Acceleration at Short Periods (0.2 Second): As per ASCE, Section 9.6.
 8. Design Spectral Response Acceleration at 1-Second Period: As per ASCE, Section 9.6.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Qualification Data: For professional engineer.
- E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC Utah State Amendments unless requirements in this Section are more stringent.

- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained Mounts: All-directional mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- F. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

- G. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid 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 and stainless-steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Ceiling markers.

1.2 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch-thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.3 CEILING MARKERS

- A. Ceiling Markers: 1/2-inch diameter color coded plastic with contact-type, permanent-adhesive backing for marking location of valves, dampers, controllers, etc. above acoustical ceiling tiles.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Heating Water Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 CEILING MARKERS

- A. Install ceiling markers in acoustical tile T-bar ceilings marking the location of valves, dampers, controllers, etc. and other items used for or requiring maintenance.

END OF SECTION 230553

SECTION 230594 - TESTING, ADJUSTING, AND BALANCING FOR HVAC – AIR/HYDRONIC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

- A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. Acceptable Test and Balance Companies
 - 1. BTC Services
 - 2. Bonneville Test and Balance
 - 3. Certified Test and Balance
 - 4. Flo Rite, Inc.

5. RS Analysis

PART 2 - PRODUCTS (Not Applicable)

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.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- 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 ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. 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.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine operating safety interlocks and controls on HVAC equipment.

- O. 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 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 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 Total System Balance", ASHRAE 111 or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material 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. 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.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical 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 inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the 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.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. 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 mode 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 airflow of submain and branch ducts.
 - a. Where sufficient space in submain 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. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 - 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

- C. Measure air 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 air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch 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 minimum set-point airflow with the remainder at maximum 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 outdoor-air dampers at minimum, and set 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 system 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 the same 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 the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 - 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same 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 that adequate static pressure is maintained at the most critical unit.
 - 8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 - 2. Set terminal units and supply fan at full-airflow condition.
 - 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 - 4. Readjust fan airflow for final maximum readings.

5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. 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 the same 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.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

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 the 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 liquid level in expansion tank.
 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 5. 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.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- B. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- C. Set calibrated balancing valves, if installed, at calculated presettings.
- D. 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.
- E. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- F. Adjust balancing stations to within specified tolerances of indicated 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.
- G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- H. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- I. Check settings and operation of each safety valve. Record settings.

3.9 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.10 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.

3.11 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the refrigerant charge.
 - 4. Check the condition of filters.
 - 5. Check the condition of coils.
 - 6. Check the operation of the drain pan and condensate-drain trap.
 - 7. Check bearings and other lubricated parts for proper lubrication.
 - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.

- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 - 4. Balance each air outlet.

3.12 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent.

3.13 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: Prepare progress 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.

3.14 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Provide a final copy of typed report to engineer.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor 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's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Inlet vane settings for variable-air-volume systems.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- D. 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 outdoor, 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.
 6. Balancing stations.
 7. Position of balancing devices.

END OF SECTION 230594

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Mineral fiber.
 - 2. Adhesives.
 - 3. Mastics.
 - 4. Sealants.
 - 5. Factory-applied jackets.
 - 6. Tapes.
- B. Related Sections:
 - 1. Division 22 Section "Plumbing Insulation."
 - 2. Division 23 Section "Metal Ducts" for duct liners.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.

- G. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

- C. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

2.4 SEALANTS

- A. ASJ Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.7 SECUREMENTS

- A. Staples: Outward-clinching insulation stapes, nominal 3/4-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- E. Blanket Insulation Installation on Ducts: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.

- f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

3.7 DUCT INSULATION SCHEDULE, GENERAL

- A. Ducts Requiring Insulation:
 1. Indoor, concealed unlined supply and outdoor air.
 2. Indoor, concealed supply and return located in nonconditioned space.
- B. Items Not Insulated:
 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 2. Factory-insulated flexible ducts.
 3. Flexible connectors.
 4. Vibration-control devices.
 5. Factory-insulated access panels and doors.

3.8 INDOOR DUCT INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density.
- B. Concealed, Return-Air Duct Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Heating-Hot-Water Supply and Return, 200 Deg F and below:
 - 1. NPS 2 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

END OF SECTION 230700

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. All pertinent sections of this specification may be part of the work described in this section. This contractor will require coordination of other trades. This contractor will have a project manager, with not less than five years experience, on site when ATC work commences to coordinate daily work activities.

1.2 SCOPE OF WORK

- A. The scope of work shall include all labor, material, and equipment necessary to extend the existing temperature control system from the district maintenance command center to this facility.
- B. The contractor under this heading shall furnish and install a complete direct digital control system as specified.
- C. The temperature controls shall be installed and certified by ATC contractor utilizing TAC controls (INET-Seven) or equal as specified. The installation of the DDC system must be approved and certified by the controls manufacturer.
- D. Install a new Direct Digital Control (DDC) system to be tied into the existing Host Computer. This DDC System shall operate over the D.A.T.C WAN Network via NET PLUS Routers.
- E. This system shall include, but are not limited to, controls and equipment as hereinafter specified.
- F. This system shall include but not be limited to controls and equipment as hereinafter specified.
 - 1. VAV Boxes
 - 2. Exhaust Fans
 - 3. Rooftop Units
- G. All control equipment hereinafter specified shall be provided by the Temperature Control Contractor under this section.
- H. All control equipment shall be manufactured by the temperature control companies listed in the bidding section of these documents.

1.3 WORK TO BE PERFORMED BY OTHERS

- A. The contractor shall carefully review all notes, coordination schedules, and drawings for work required under this section of the specification.
- B. Division 26 shall furnish and install all single phase and multiple phase electrical power wiring to magnetic starters, disconnect switches, and motor. Division 26 shall also provide 120 power to each ATC panel as shown on the plans. ATC contractor shall be responsible for step down transformers and 24 VAC wiring to ATC equipment
- C. The sheet metal contractor shall install all dampers supplied by the ATC contractor. Each damper shall be installed so that it will operate freely and without binding. Each damper shall be checked and those not properly installed shall be replaced or reinstalled without cost to the ATC contractor.

1.4 RELATED WORK

- A. Mechanical contractor to install all control valves, wells for temperature sensors, and this contractor to supply location and temperature sensors wells.

1.5 ELECTRICAL WIRING

- A. The controls contractor shall hold a current electrical license for the State of Utah (no subcontracting shall be allowed on this project) and shall install all wiring and conduit for the DDC system. All power wiring to control panels will be done by the Division 26 contractor.
- B. All control wiring shall be installed in conduit in open areas and concealed inaccessible ceilings in accordance with the National Electrical Code. Plenum rated cable may be used in concealed accessible areas in accordance with the National Electrical Code.

1.6 SUBMITTALS

- A. Prior to any installation, the contractor shall submit, with 30 days after award of contract, a complete submittal package. This submittal shall contain six (6) copies of complete literature on all control equipment including control diagrams as per the sequence of operation.
- B. The following shall be submitted for approval:
 - 1. Data sheets for all control systems and components.
 - 2. Valve schedules, showing sizes, configuration capacity and location of all equipment.
 - 3. Control system drawings containing pertinent data to provide a functional operating system, including a sequence of operation. Detailed shop drawings may be submitted in an as installed form upon project completion.
- C. Drawings:
 - 1. After completion of contract, the supplier shall submit review drawings, installation and operation instruction and a recommended spare parts list.
 - 2. Drawings shall be standard sizes (24 inches x 36 inches) or (11 inches x 17 inches).
 - 3. Provide three copies of as installed drawings.
- D. System documentation by the vendor shall include the following as a minimum:
 - 1. System configuration diagrams in simplified block format.
 - 2. Input/Output point and alarm point summary listing.
 - 3. Electrical drawings showing all system internal and external connection points, terminal block layouts and terminal identification.
 - 4. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
 - 5. Overall system operation and maintenance instructions, including preventive maintenance and troubleshooting instructions.
 - 6. Complete recommended spare parts list.

1.7 PROJECT MANAGEMENT

- A. Provide a designated project manager who will be responsible for the following:
 - 1. Maintain project schedule.
 - 2. On-site coordination with all applicable trades and subcontractors.
 - 3. Attend project meetings.
 - 4. Make necessary field decisions.

1.8 WARRANTY

- A. Provide all services, materials and equipment necessary for a one-year period after substantial completion inspection.

1.9 TRAINING

- A. Training will consist of a total of 24 hours. Classes will be broken into separate sessions at the owner's discretion.

1.10 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate equipment with Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

PART 2 - PRODUCTS AND EQUIPMENT

2.1 APPROVED MANUFACTURERS AND INSTALLERS

- A. Approved DDC control equipment and is:
 - 1. TAC DDC
 - a. Approved Installation Contractors:
 - 1) Utah Controls 990-1950

2.2 VALVES

- A. ATC valve bodies 2" and smaller shall be screw type; larger valves shall be flanged. Screwed valves shall be rated at 150 psi or greater and shall have cast iron or brass bodies. Flanged valves shall be rated at 250 psi or greater and have cast iron or steel bodies. All automatic valves shall be for DDC control application. All valves shall be disc/plug and seat or ball construction. Valves to be sized for a 3-lb. max. pressure drop.

2.3 BUILDING MANAGEMENT SYSTEM (BMS)

- A. The building management system shall permit full operator communication and control, including obtaining information about performance of this system; changing times and parameters; adding or deleting points; changing relationships between sensors and controlled equipment; creating or modifying control strategies; and diagnosing system malfunctions. English language prompting format shall be used. The operator will be presented with options at the CRT in English. Features of the system will be compatibility to run on Windows 2000 or NT. System to have integrated access control; TCP/IP protocol communication; support for net plus routers; open database support; integrated graphic editor; asynchronous auto-dial/auto answer, and one way dialing. This contractor shall provide all software required for efficient operation of all the automatic system functions required by this specification. Software shall be modular in design for flexibility in expansion or revision of the system. It is the intent of this specification to require provisions of a system, which can be fully utilized by individual with no, or limited, previous exposure to PC's and programming techniques and languages. If the system to be provided requires the use of any modified BASIC, "C", PASACAL, or DRUM Language program, or writing "line" programming statements to modify operation or strategy in the system, the vendor shall provide unlimited, no charge, software modification and support for a period of five (5) years after the completion of the project in addition to the warranty period specified elsewhere. Systems, which are factory programmed, are unacceptable. Direct Digital Control (DDC) Modules: Each DCU shall provide "Block" or "Modular" programming software so that the operator can easily develop custom control strategies and sequences of operation, without learning a programming language.

- B. Control loops and sequences shall be defined using “modules” that are analogous to traditional pneumatic or electric control devices. Modules may be linked together to form more complex control strategies. The use of mathematical equations, “BASIC”, or proprietary programming languages for defining a DDC control loop is unacceptable.

2.4 LOCAL AREA NETWORKS (LAN)

- A. Controller LAN: The FMS shall provide communication between DCU's over a Local Area Network (LAN).
- B. The controller LAN shall be a “bus type” network over which formation is transmitted in a “token passing” fashion between all the nodes on the network.
- C. The controller LAN shall have the capacity to contain not less than 64 nodes as a minimum. Each workstation, DCU, or “gateway” device shall represent a node to the network.
- D. The Controller LAN shall connect the nodes in a fully distributed environment, each DCU operating autonomously while communicating with all other nodes on the network. Controller LANs requiring a communication controller (for any reason) will not be acceptable. LAN lengths in excess of 24,000 ft. shall be supported.
- E. A break in the communication path of the controller LAN shall be announced as an alarm and shall automatically initiate a Controller LAN reconfiguration such that the resulting sections of the Controller LAN continue to function as separate LANs. No loss of control shall result from such a break in the Controller LAN.
- F. Commercial LAN: Workstations on the Controller LAN may also reside on a higher tier “commercial” LAN. This “commercial” LAN shall be based on Ethernet, and comply with IEEE 802.3 standards. Where a “commercial” LAN is implemented, it shall be possible to connect multiple Controller LANs together, with a global data sharing across this commercial LAN.
- G. Data speed shall not be less than 10 Megabaud.
- H. An operator at a workstation on the “commercial” LAN may connect to any other workstation on the “commercial” LAN as if the operator was sitting at the other workstation.
- I. Alarms and special event notices shall be routed to different workstations on the “commercial” LAN based on time of day, and day of week.
- J. Operator password assignment shall be available on both a system-wide basis and a workstation-by-workstation basis.

2.5 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of date of Supplier's Proposal, and any subsections thereof as applicable, shall govern design and selection of equipment and material supplied:
 - 1. ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers.
 - 2. IBC International Building Code, including local amendments.
 - 3. UL 916 Underwriters Laboratories Standard for Energy Management Equipment.
 - 4. NEC National Electrical Code.
- B. City, county, state and federal regulations and codes in effect as of date of purchase.
- C. Except as otherwise indicated, vendor shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

PART 3 - EXECUTION

3.1 DIRECT DIGITAL CONTROL SYSTEM-OVERVIEW

- A. The direct digital control system shall consist of local microprocessor-based digital control panels (DCP) network together for information sharing and operating convenience and a central operator interface station.
- B. It is the intent of these specifications to create a combined direct digital control system. All system type control functions, such as those used for fan systems, boilers, chillers, central plant and pumps, building pressure, etc., shall be accomplished by using software algorithms in the respective DCP.
- C. Each major mechanical component (fan system, chiller, boiler, etc.) shall have its own dedicated DCP so that failure of any will not result in catastrophic system failure. DCP's utilizing a master-slave relationship shall have a master unit provided for each major mechanical system.
- D. All safety devices such as fire alarm shutdown, smoke detectors, low limit thermostats, etc. shall be hard wired to accomplish their critical functions completely independent of the DCP and shall have additional outputs as required to sever as inputs to the DCP for secondary control and reporting functions.

3.2 CONTROLLER (DCU)

- A. The controller shall be a microprocessor and shall form the basic control unit of the system. It shall operate as a stand-alone unit providing all the necessary algorithms and software logic to perform the local HVAC control sequences and energy saving functions. Failure of any one DCU shall have no effect on the other DCU's in the system. Programming shall be block type and accomplished by the operator's terminal, or the remote operator terminal. The DCU shall have the ability for direct digital control; automatic time scheduling; demand limiting; calculated points universal inputs with configurable outputs; an RS-485 Lan port; an RS-232 port; an TTL port for hand held console; trend sampling, and on line editing capability. The controller shall operate independent of any central computer, shall have built in diagnostic routines, and shall have 72-hour battery back up.
- B. Inter-computer communications shall support true global token passing control strategies as well as allow data status and values connected to one DCU to be used within application programs of another DCU.
- C. The system shall provide a network communication facility to support global calculation and control strategies to be continuously implemented in the distributed system. The system shall provide for events detected in any area of the total network to initiate commands to any other device within the network. The system shall also provide for connected or calculated data to be continuously shared between any or all controllers within the total network. Though the DCU's may share no critical sensor information, at no point within the facility shall quick reacting and constantly changing point information be communicated via the network bus. These types of points shall be hardwired to the DCU in which the algorithm exists.

3.3 ROUTER AND SECURITY OF CONTROL SYSTEM

- A. Provide and install an Ethernet router at this site to provide constant on-line monitoring by the facility personnel. This device shall serve as the network interface between the ATC control/controllers at the remote site and the existing Wide Area Network (WAN). This router to tie directly to the TAC control system. The router shall support the following protocol, Telnet via TCP, SNMP via UDP, and ATC contractor's proprietary protocol via UDP. The router shall require a Static IP address. Subnet Mask and Gateway provided by the network administrator.

The maximum allowable transmission/response packet sizes shall not exceed 186 bytes, and acknowledge/response packet sizes shall not exceed 64 bytes. UDP packets shall be proprietary to the control system with critical packets using a private key encryption for security.

3.4 TEMPERATURE SENSORS

- A. Provide thermistor or thin film silicon sensors for all temperature applications, except differential chilled water for BTU calculation, where precision matched Platinum RTDs shall be used. Solid-state sensors shall be linear, drift free, and require only a one-time calibration. A look-up table in the connected controller shall linearize thermistors or similar non-linear temperature devices. Resolution shall be better than .5 degrees F for Micro Controller applications, and better than .2 degrees F for DCP applications.
- B. Space sensors shall have an integral port for connection of a portable "intelligent" sensor to communicate with its DCP. This port and portable "intelligent" sensor may be used for initiating the "test mode" locally to verify all DCP control sequences, and perform test and balancing functions. To eliminate the downtime associated with rechargeable batteries the portable "intelligent" sensor shall receive its power from the sensor port.

PART 4 - EXECUTION

4.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the Owners Representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.

4.2 INSTALLATION (GENERAL)

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to insure a complete operating system in accordance with the sequences of operation and point schedules.

4.3 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 60 inches above floor with minimum 3'-0" clear access space in front of units. Obtain Owner Representative's approval on locations prior to installation.
- B. All instruments, switches, etc. shall be suitably wired and mounted to protect them from vibration and high temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags to all panels.
- D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections; sized to suit pipe diameter without restricting flow.

4.4 INTERLOCKING AND CONTROL WIRING

- A. Provide all interlock and control wiring. All wiring shall be installed in a neat and professional manner in accordance with Division 26 and all state and local electrical codes.

- B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions.
- C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the Owner's Representative prior to rough-in.
- D. Provide auxiliary pilot duty relays on motor starters as required for control function.
- E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings; coordinate with electrical contractor.
- F. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed in a neat and inconspicuous manner per local code requirements.

4.5 DEMONSTRATION

- A. Provide systems demonstration under provisions of Division 23.
- B. Demonstrate complete and operating system to Owner's Representative.
- C. Provide certificate stating that control system has been tested and adjusted for proper operation.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATION FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. See Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.2 SUBMITTALS

- A. Shop Drawings: Written descriptions and diagrams of operational sequences.

1.3 ROOFTOP UNIT/EXHAUST FAN

- A. Building Automation System (BAS) shall control unoccupied and occupied status of systems.
- B. Adjustable heating and cooling set points shall control space temperature by activating either heating or cooling components.
- C. Outside air damper shall open to minimum position in occupied mode and modulate open further to maintain space pressure. Classrooms shall be negative 0.02 in w.g. with respect to the corridor.
- D. Enthalpy economizer to operate in sequence with mechanical cooling.
- E. Relief air steam to be enabled during economizer operation and shall modulate or stage based on space pressure.
- F. Enable exhaust fan in occupied mode and increase fan speed with VFD to maintain space pressure as defined above.

1.4 VAV REHEAT BOXES (NEW AND EXISTING)

- A. Room sensor/controller modulates the damper to maintain minimum and maximum CFM setpoints as call for cooling goes for 0-100%. As the VAV boxes require heat the controller will modulate automatic hot water 2-way valve and open the VAV box to reheat minimum CFM to maintain room temperature. In the unoccupied mode the VAV box closes completely and fan will cycle and valve will open to maintain lower space temperature.

1.5 COMMUNICATION TO CENTRAL SYSTEM

- A. The ATC Contractor shall develop floor plans (similar to existing) of the building showing all space temperatures.
- B. All setpoints shall be fully adjustable from the central office. Local adjustments shall be by the use of a portable operator's terminal.

END OF SECTION 230993

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 1. Hot-water heating piping.

1.2 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 1. Hot-Water Heating Piping: 150 psig at 200 deg F.

1.3 SUBMITTALS

- A. Product Data: For each type of the following:
 1. Plastic pipe and fittings with solvent cement.
 2. Pressure-seal fittings.
 3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 4. Air control devices.
 5. Chemical treatment.
 6. Hydronic specialties.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

- F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.

- G. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company of America.
 - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 4. Fittings and couplings used in systems with expansion fittings and loops shall be zero-flex type.

2.2 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

- F. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

- G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

- B. Insulating Material: Suitable for system fluid, pressure, and temperature.

- C. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
 - c. Victaulic Company of America
2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F. Use in conjunction with standard union.

2.4 VALVES

- A. Ball Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - g. Tour & Andersson; available through Victaulic Company of America
 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Plug: Resin.
 5. Seat: PTFE.
 6. End Connections: Threaded or socket.
 7. Pressure Gage Connections: Integral seals with stops for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. CWP Rating: Minimum 125 psig.
 10. Maximum Operating Temperature: 250 deg F.

2.5 HYDRONIC PIPING SPECIALTIES

- A. 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: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
 1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- L. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- M. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- N. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- O. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- P. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

- Q. Install strainers on inlet side of each control valve, pressure-reducing valve elsewhere as indicated. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- R. Identify piping as specified in Division 23 Section "Identification for HVAC Piping & Equipment."

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping Equipment."
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.

3.7 CHEMICAL TREATMENT

- A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
 - 1. Open manual valves fully.

2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rectangular ducts and fittings.
 - 2. Round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.
 - 6. Seismic-restraint devices.
 - 7. Acoustical liner.

- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 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.
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 - 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 - 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

- B. Air Stream Surfaces: Surfaces in contact with the air stream shall comply with requirements in ASHRAE 62.1-2004.

1.3 SUBMITTALS

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

- B. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

1.5 FIELD VERIFICATION

- A. No ductwork shall be fabricated without first field verifying that the available space under actual job conditions will permit installation of the ductwork without structural or other conflicts. Duct

sizes that require on the job modification due to unforeseen obstructions shall be made without any additional cost to the owner.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.

- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 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.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. 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.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 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. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 3 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 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. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. 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.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Ductmate Industries, Inc.
 3. Hilti Corp.
 4. Kinetics Noise Control.
 5. Loos & Co.; Cableware Division.
 6. Mason Industries.
 7. TOLCO; a brand of NIBCO INC.
 8. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.7 DUCT LINER

- A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124
1. Manufacturers:
 - a. CertainTeed Corp.; Insulation Group.
 - b. Johns Manville International, Inc.
 - c. Knauf Fiber Glass GmbH.
 - d. Owens Corning.
 2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
 - a. Thickness: 1 inch.
 - b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - d. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - e. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
 - 1) Tensile Strength: Indefinitely sustain a 50-lb-tensile, dead-load test perpendicular to duct wall.
 - 2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.

- 3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
3. Install liner in all square and rectangular supply, return, mixed air, exhaust and transfer air ducts. Duct dimensions on drawings are clear inside dimensions.

2.8 APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
- B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
- G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 1. Fan discharges.
 2. Intervals of lined duct preceding unlined duct.
 3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.
- I. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 1. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
- J. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets or welds.

2.9 CLOTHES DRYER VENT

- A. Run .032 gauge longitudinal lock seam aluminum round 4" diameter, from dryer locations, 12" above floor, with 5" protrusion into finished space for connection to dryer. Run directly to roof or wall using a minimum of 2 elbows:
 1. Roof Termination:
 - a. Extend above roof to 24" and turn with cap/integral backdraft damper at outlet. Provide 14" high flashing cone, and counter-flash over cone.
 2. Wall Termination:
 - a. Architectural wall cap with integral backdraft damper.

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 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 Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. 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. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.

6. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
7. Conditioned Space, Exhaust Ducts: Seal Class B.
8. Conditioned Space, Return-Air Ducts: Seal Class C.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 6. Supply-air ducts, dampers, actuators, and turning vanes.
 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 6. Provide drainage and cleanup for wash-down procedures.
 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.6 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

- A. Supply Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units, and rooftop units (0-2000 CFM):
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
 2. Ducts Connected to Variable-Air-Volume Air-Handling Units, and rooftop units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 3.

- d. SMACNA Leakage Class for Round and Flat Oval: 3.
 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 3.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
 - B. Exhaust Ducts:
 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
 - C. Elbow Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - b. Velocity 1000 fpm or Higher:
 - 1) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) 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 or Welded.
 - D. Branch Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: HET.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: HET.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Flange connectors.
 - 3. Turning vanes.
 - 4. Duct-mounted access doors.
 - 5. Flexible connectors.
 - 6. Flexible ducts.
 - 7. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

6. Blade Axles: Nonferrous metal.
 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
1. Size: 1-inch diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.3 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.4 TURNING VANES

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

- E. Vane Construction: Single wall.
- F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.5 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Flexmaster U.S.A., Inc.
 - 5. Greenheck Fan Corporation.
 - 6. McGill AirFlow LLC.
 - 7. Nailor Industries Inc.
 - 8. Pottorff; a division of PCI Industries, Inc.
 - 9. Ventfabrics, Inc.
 - 10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
 - 1. Door and Frame Material: Galvanized sheet steel.
 - 2. Door: Single wall with metal thickness applicable for duct pressure class.
 - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 - 4. Factory set at 10-inch wg.
 - 5. Doors close when pressures are within set-point range.
 - 6. Hinge: Continuous piano.
 - 7. Latches: Cam.
 - 8. Seal: Neoprene or foam rubber.
 - 9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.6 DUCT ACCESS PANEL ASSEMBLIES

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

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

2.7 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
1. Pressure Rating: 8-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.
- C. 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: 4-inch wg positive and 0.5-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 175 deg F.
 4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1-2004.
- D. Flexible Duct Connectors:
1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.
 2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
 2. Install aluminum volume dampers in aluminum ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On both sides of duct coils.
 2. Upstream and downstream from duct filters.
 3. At outdoor-air intakes and mixed-air plenums.
 4. At drain pans and seals.
 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 7. At each change in direction and at maximum 50-foot spacing.
 8. Control devices requiring inspection.
 9. Elsewhere as indicated.
- F. Install access doors with swing against duct static pressure.
- G. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
 2. Two-Hand Access: 12 by 6 inches.
 3. Head and Hand Access: 18 by 10 inches.
 4. Head and Shoulders Access: 21 by 14 inches.
 5. Body Access: 25 by 14 inches.
 6. Body plus Ladder Access: 25 by 17 inches.
- H. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- I. Install flexible connectors to connect ducts to equipment.
- J. Connect terminal units to supply ducts with maximum 36-inch lengths of flexible duct. Do not use flexible ducts to change directions. Flexible ductwork shall be installed above accessible ceilings only.
- K. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place. Flexible ductwork shall be installed above accessible ceilings only.
- L. Connect flexible ducts to metal ducts with draw bands.
- M. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.

2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233423 – HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Centrifugal roof ventilators.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.3 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. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Existing Belt-Driven Drive Assembly:
 - 1. New Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 2. New Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 3. New Fan motor.

2.2 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install ducts adjacent to power ventilators to allow service and maintenance.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 2. Verify that cleaning and adjusting are complete.
 - 3. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 4. Adjust belt tension.
 - 5. Verify lubrication for bearings and other moving parts.
 - 6. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 7. Shut unit down and reconnect automatic temperature-control operators.
 - 8. Remove and replace malfunctioning units and retest as specified above.

- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233423

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Shutoff, single-duct air terminal units.

1.2 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.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Anemostat Products; a Mestek Company.
 - 2. Krueger.
 - 3. METALAIR, Inc.
 - 4. Nailor Industries Inc.
 - 5. Price Industries.
 - 6. Titus.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch steel, single wall.
 - 1. Casing Lining: Adhesive attached, 1-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071, 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.
 - a. Cover liner with nonporous foil.
 - b. Cover liner with nonporous foil and perforated metal.
 - 2. Casing Lining: Adhesive attached, 1-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.
3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 4. Air Outlet: S-slip and drive connections, size matching inlet size.
 5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- E. Hydronic Coils: 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.
- F. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC".

2.2 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Steel Cables: Stainless steel complying with ASTM A 492.
- C. 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.
- D. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

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. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes 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. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items 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: In addition to requirements in Division 23 Section "Hydronic 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. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."
- D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

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 Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. 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. Engage a factory-authorized service representative to 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. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Fixed face registers and grilles.
- B. Related Sections:
 - 1. Division 23 Section "Air Duct Accessories" for volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Rectangular and Square Ceiling Diffusers:
 - 1. Products:
 - a. Titus TDC or TDCA
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A-J Manufacturing Co., Inc.
 - b. Anemostat Products; a Mestek company.
 - c. Carnes.
 - d. Hart & Cooley Inc.
 - e. Krueger.
 - f. METALAIRE, Inc.
 - g. Nailor Industries Inc.
 - h. Price Industries.
 - i. Titus.
 - j. Tuttle & Bailey.
 - 3. Material: Steel.
 - 4. Finish: Baked enamel, color selected by Architect.
 - 5. Face Size: As scheduled.
 - 6. Face Style: Louvered.
 - 7. Mounting: Surface or T-bar.
 - 8. Pattern: Fixed.
 - 9. Dampers: None.

2.2 REGISTERS AND GRILLES

- A. Fixed Face Register:

1. Products:
 - a. Titus PAR
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A-J Manufacturing Co., Inc.
 - b. Anemostat Products; a Mestek company.
 - c. Carnes.
 - d. Dayus Register & Grille Inc.
 - e. Hart & Cooley Inc.
 - f. Krueger.
 - g. METALAIRE, Inc.
 - h. Nailor Industries Inc.
 - i. Price Industries.
 - j. Titus.
 - k. Tuttle & Bailey.
 3. Material: Steel or Aluminum.
 4. Finish: Baked enamel, color selected by Architect.
 5. Face Arrangement: Perforated.
 6. Core Construction: Removable.
 7. Frame: Surface or lay-in.
- B. Fixed Face Register (louvered):
1. Products:
 - a. Titus 355R
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A-J Manufacturing Co., Inc.
 - b. Anemostat Products; a Mestek company.
 - c. Carnes.
 - d. Dayus Register & Grille Inc.
 - e. Hart & Cooley Inc.
 - f. Krueger.
 - g. Nailor Industries Inc.
 - h. Price Industries.
 - i. Titus.
 - j. Tuttle & Bailey.
 3. Material: Steel or Aluminum.
 4. Finish: Baked enamel, color selected by Architect.
 5. Face Blade Arrangement: Horizontal spaced 1/2" apart.
 6. Core Construction: Integral.
 7. Frame: 1-1/4 inches wide.
 8. Mounting: Surface or lay-in..

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design

requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

DATC COSMETOLOGY REMODEL

SECTION 26 0500 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the drawings and/or in these specifications, including all labor, services, permits, fees, utility charges, and incidentals necessary and required to perform and complete the electrical work described in this Division. Apply for all permits early in the project to avoid problems due to code revisions.
- B. See the contract conditions (general and supplementary) and Division 1 for requirements concerning this Division including, but not limited to, submittals, shop drawings, substitution requests, change orders, maintenance manuals, record drawings, coordination, permits, record documents and guarantees.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Mechanical equipment motors to be furnished under another Division but connected under this Division. Starters to be mounted and connected by this Division, but furnished by another Division unless otherwise noted on the electrical drawings. Motor control centers shall be furnished and installed under this Division of the work. Verify and coordinate all equipment locations and electrical characteristics with other trades involved in the work. Coordination shall be done prior to rough-in or ordering equipment.
- B. Control wiring for mechanical equipment beyond provisions shown on the Electrical Drawings shall be performed under another Division of the work.

1.3 QUALITY ASSURANCE:

- A. Do all work in accordance with regulations of serving electric utility, telephone utility, cable TV utility, National Electrical Code, state and local codes and amendments, National Fire Codes, and all other applicable codes.

1.4 PROJECT CONDITIONS:

- A. The Contractor shall inspect the job site prior to bidding and familiarize himself with existing conditions which will affect the work. Prior to start of work, obtain "As built", "Record", or other Drawings showing existing underground utilities.
- B. Electrical drawings are diagrammatic indicating approximate location of outlets, lighting fixtures, electrical equipment, etc. Consult the Architectural, Structural, and Mechanical Drawings to avoid conflicts with equipment, structural members, etc. When required make all deviations from Drawings to make the work conform to the building as constructed, and to related work of others. Minor relocations ordered prior to installation may be made without added cost to Owner.

DATC COSMETOLOGY REMODEL

- C. Call to the attention of the Architect any error, omission, conflict or discrepancy in Drawings and/or Specifications. Do not proceed with any questionable items of work until clarification of same has been made.
- D. Under no conditions are beams, girders, footings or columns to be cut for electrical items unless so shown on Drawings or written approval obtained from the Architect.
- E. Verify the physical dimensions of each item of electrical equipment to fit the available space and promptly notify the Architect prior to roughing-in if conflicts appear. Coordination of equipment to the available space and to the access routes through the construction shall be the Contractor's responsibility.

1.5 SHOP DRAWINGS:

- A. Prior to ordering equipment, and prior to Contractor's first application for payment, the Contractor shall, within 14 days after award of this work, submit six (6) complete shop drawings, neatly bound in 3-ring binder form, with indexed tabs, to the Architect, of materials and equipment he proposes to furnish. It is preferred that all sections be submitted at once, however, in the event that one or more sections need approvals quickly and others are not prepared yet, the Engineer will agree to review the individual section submittals needing immediate approval. However, each individual submittal section must be complete, and remaining submittals that are not a rush shall be submitted all in one package as quickly as possible. Submitting individual sections over many weeks/months will not be tolerated.
- B. List shall bear Contractor's stamp, signature or other means to show that he has inspected same and certified that submitted material is correct in regard to quantity, size, dimension, quality and is coordinated with the Contract Documents.
- C. See individual sections within this Division for products requiring submittal.
- D. Each shop drawing submittal shall be prepared by the manufacturer, and shall clearly show manufacturer's name, catalog numbers, pictures, details, layout, type, size, rating, style, and all options identified in a permanent fashion. Specific items or options shall be permanently marked on sheets containing more than one option – do not rely on the Engineer to mark options. Yellow highlight will not be an acceptable means of marking.
- E. Large equipment drawings such as UPS systems, generators, transformers, switchboards, and similar large equipment shall include the size, weight, seismic rating, emissions data, elevation, and wiring diagrams in addition to the product data.
- F. Some sections of this Division may require shop drawings prepared on full size floor plans in AutoCAD or other CAD software. Where required, contact the Architect for the latest version of the floorplans and match the size and scale of the construction drawings. Drawings delivered to the contractor from the Architect/Engineer may not include addenda changes. Contractor shall only use floor plans for purposes of the construction on this job, and not for any other use or reuse. Add any required addenda items prior to finishing submittals.

DATC COSMETOLOGY REMODEL

- G. Provide complete materials (all materials) list at the beginning of each tabbed section showing "Specification Section", "Material Item", "Manufacturer's Name and Catalog Number", and all pertinent data.
- H. Provide samples were required in individual sections of this Division.
- I. Contractor agrees that Shop Drawing Submittals processed by the Architect are not Change Orders; that the purpose of Shop Drawing Submittals by the Contractor is to demonstrate to the Architect that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.
- J. Contractor further agrees that if deviations, discrepancies or conflicts between Shop Drawings and Specifications are discovered either prior to or after Shop Drawing Submittals are processed by the Architect, the design Drawings and Specifications shall control and shall be followed.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. All materials shall be new and bear manufacturer's name, model number, electrical characteristics and other identification. All equipment to be U.L. approved or listed by another testing agency approved by authorities having jurisdiction.
- B. Material and equipment shall be standard product of manufacturer regularly engaged in production of similar material for at least five years (unless specifically exempted) and shall be manufacturer's latest design.
- C. If the description of a product is in conflict with the product as specified in the catalog number, the description shall generally take precedence. Contact the Architect for clarification if this occurs.
- D. All equipment for essential or life safety systems must be rated and certified for the appropriate seismic design category or seismic use group for the installed location.

2.2 DISCONNECTS:

- A. Safety and disconnect switches to be General duty quick-make, quick-break, dual rated, lockable, and of such electrical characteristics as required for the load served. Switches to have defeatable cover interlock.
- B. Fuse clips shall accept Class R or Class L fuses if required. Motor rated toggle switches equal to Square D Class 2510, type F with thermal overloads may be used as motor disconnects in dry locations.
- C. Disconnect switches required by code shall be installed whether or not specifically shown on the Drawings. Disconnect switches for refrigeration equipment and multiple motor HVAC equipment shall be fusible type.

DATC COSMETOLOGY REMODEL

- D. Safety and disconnect switches (fuse, non-fuse or circuit-breaker type) to be of same manufacturer as switchgear and panelboards.
- E. Elevator Power Module (EPM):
 - 1. Rated as indicated on the plans, 600 VAC and 200,000 amps RMS interrupting current.
 - 2. Features shall include, but are not limited to 120V shunt trip capabilities, control power transformer and terminal block, ground lug, fire safety interface relay, and status indicating pilot lights.
 - 3. Provide with Class J fuses, sized per elevator manufacturer's recommendations.
 - 4. Power Module shall be equal to Bussmann PS1 series, Ferraz Shawmut or approved.

2.3 FUSES:

- A. Provide fuses as indicated on the drawings, sized per NEC, or as required by the equipment manufacturer, whichever provides maximum protection, for a fully operational system.
- B. All fuses shall be furnished of the same manufacturer.
- C. All fuses shall be installed by the electrical contractor at job-site and only when equipment is to be energized. Fuses shall not be installed during shipment.
- D. All fuses to be 200,000 AIC, Current-limiting, U.L., Time Delay, Dual-element Type as follows:
 - For feeders 601 Amps to 6000 Amps:
Class L, KRP-C, KLPC, & A4BQ
 - For feeders 600 Amps and less:
Class Rk-1 for 600 volt; LPS-RK, LLS-RK, & A6D-R
Class RK-1 for 250 volt; LPN-RK, LLN-RK, & A2D-R
Class J; JHC, JTD, & AJT
 - For motor circuits beyond the main and subdistribution boards, 600 volt and below:
Class RK-5 for 600 volt; FRS-R, FLS-R, & TRS-R
Class RK-5 for 250 volt; FRN-R, FLN-R, & TR-R
- E. SPARE PARTS: Provide 10% spare fuses, but not less than 3 of any one size and type.
- F. Provide Spare Fuse Cabinet(s), #SFC, #LSFC, & ATFC as required. Install cabinet(s) in Main Electrical Room.
- G. Approved Manufacturers, with catalog numbers listed in order: Bussman, Littelfuse, Ferraz Shawmut.
- H. If the electrical contractor wishes to furnish materials other than those specified, a written request, along with a complete short circuit and selective coordination study, shall be

DATC COSMETOLOGY REMODEL

submitted to the engineer for evaluation at least 8 days prior to the bid date. If the engineers evaluation indicates acceptance, a written addendum will be issued listing the other acceptable manufacturer.

2.4 BOXES:

- A. Outlet and junction boxes shall be sized in accordance with code requirements or as noted on the drawings.
- B. Unless otherwise specified or shown on the drawings, all outlet boxes for new work shall be galvanized steel knockout, outlet boxes. Gangable boxes are not acceptable. Outlet boxes shall not be smaller than 4" square and 1-1/2 inches in depth, unless otherwise noted. All outlet box covers, rings, or other fittings shall be galvanized. Boxes which are exposed to the weather shall be cast metal. Outlet boxes for phone and data outlets shall be 2.5" deep boxes.
- C. Outlet boxes shall be designed for the intended use, and shall be installed flush with finish surface lines or not more than 1/8 inch back and shall be level and plumb. Long screws with spaces or shims for mounting devices are not acceptable. No combustible materials shall be exposed to wiring at outlets.
- D. Outlet boxes on opposite sides of fire or sound isolating partitions shall have a minimum horizontal separation of 24". Back to back boxes are not permitted in any walls.
- E. Floor boxes, unless otherwise shown, to be Hubbell B-2527 if sufficient slab depth, otherwise B-2527 box. Provide S-3925 duplex flap cover for power, or S-2525 cover for communications, and where carpeted with S-3079 polycarbonate or metal/brass carpet flange.
- I. Floor boxes which contain voice and data cable often are shown with an empty conduit running up a wall and stubbing into the ceiling. Where no conduit is shown, stub a 1" conduit out the bottom of the low voltage section of the box and into the ceiling space of the floor below.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION METHODS:

- A. All items, articles, materials, and equipment specified under this Division shall be installed per the manufacturer's installation instructions. Where the manufacturer's instructions are in conflict with the directions provided elsewhere in this Contract, the Engineer shall be notified prior to beginning rough-in.
- B. Cutting or notching shall be kept to an absolute minimum and done when, and in a method approved by the Architect. Patch and correct finished surfaces damaged by electrical work.
- C. Relays, panels, cabinets and equipment shall be level and plumb and installed parallel with structural building lines. All equipment and enclosures shall fit neatly without gaps, openings, or distortions. Provide approved devices for closing all unused openings.

DATC COSMETOLOGY REMODEL

- D. Arrange circuit wiring as shown on the Drawings and do not alter or combine runs or homeruns without the specific approval of the Architect. Feeder runs shall not be recombined or altered.
- E. Contactors, transformers, starters and similar noise producing devices shall not be placed on walls which are common to occupied space.
- F. Ballasts, contactors, starters, transformers and like equipment which are found to be noticeably noisier than other similar equipment on the project will be deemed defective and shall be replaced.
- G. In general, the mounting heights shall be as noted on the Drawings, or as listed below, the Architectural Interior Elevations and drawing notes taking precedence. Where no heights are indicated, request clarification from the Architect. Consult the Architectural, Mechanical and Structural drawings to avoid conflicts prior to roughing-in and for exact locations. All dimensions are to the center of the device unless otherwise noted. Lighting dimensions are to the bottom of suspended fixtures and center of wall mounted fixtures unless otherwise noted.
- | | |
|--|---|
| Light Switches | 45 inches |
| Convenience Receptacles | 18 inches |
| Panelboard top | 72 inches |
| Fire Alarm Signals | 96 inches to top (but at least 6" below ceiling) |
| Fire Call Stations | 45 inches |
| Data/Telephone Outlets | 18 inches |
| Receptacles and Outlets
Over Counters | 8 inches above counter or 3
inches above backsplash, whichever is greater. |
- H. Where raceways penetrate floors, ceilings, ducts, chases, and fire walls, provide fire stopping to maintain integrity of the fire assembly. Firestopping method shall be approved by the Code Authority having jurisdiction.
- I. All materials and equipment installed under this work shall be properly and adequately supported from the building structure except where ceiling construction or other provisions are specifically designed to support them. Support systems shall provide a safety factor of four. This shall apply to chains, hangers, anchors, clamps, screws, structural iron, and all other hardware and appurtenances associated with the support system.
- J. Rough-in for communications outlets for phone and data systems shall consist of a 4" square deep (4SD) box with a single gang mud ring. Provide a .75" conduit for wall phones and a 1" conduit for combination voice and data outlets to an accessible ceiling space. Conduit shall be terminated above the ceiling in a bushing and a pull string installed.
- K. Maintain the following minimum separations from voice and data cables. Power conduit - 12", transformers and motors - 40", fluorescent lighting - 12". Coordinate with the voice and data installer to assure these separations are met.

DATC COSMETOLOGY REMODEL

3.2 LOW VOLTAGE WIRING METHODS:

- A. Unless stated otherwise in these specifications, or on the drawings, raceways for low voltage wiring of Occupancy Sensors, Paging, Intercom, TV Cabling, Computer, and Telephone systems utilizing N.E.C. class II current limitation methods will be required only in walls, inaccessible ceilings, and areas where conductors might be exposed to physical damage. Security CCTV, Intrusion Detection Systems, and Card Access Systems shall be installed in conduit for entire length of homeruns.
- B. Where cables pass through air plenums, the cables shall be either in conduit, or be plenum rated. The ceiling spaces in this project generally serve as air plenums and will require either conduit or plenum rated cable.
- C. Conductors shall be concealed in all finished spaces and shall be run parallel to structural lines and supported at minimum 5' intervals from structure.
- D. All low voltage cable must be suitable for the conditions in which it will be used. Prior to purchasing or installing any cable, confirm with the Mechanical Contractor which areas, if any, require plenum rated cable.
- E. Provide a box, plaster ring, and conduit with insulated bushing from each wall or floor outlet to an accessible ceiling or crawl space. Conduit shall be minimum 3/4" for telephone, minimum 1" combined voice and data outlets, and sized as needed for other systems. Drawings notes shall take precedence. Raceways for phone and data cable shall be sized based on the number of cables in accordance with the following guidelines.
 - 3/4" conduit - max 4cables
 - 1" conduit - max 8 cables
 - 1.25" conduit - max 14 cables
 - 1.5" conduit - max 19 cables
 - 2" conduit - max 32 cables
- F. Furnish and install all necessary sleeves and raceways to permit the installation of signal cables (specific attention is called to non-contiguous ceiling spaces) to the appropriate equipment termination point. Provide sleeves through all fire-rated walls and partitions. No outlets of any type shall be left without a raceway system or accessible ceiling path to their termination point. Verify that raceway sizes and quantities are appropriate and will have at least 50% spare capacity after all cables are initially installed. Provide at least one empty spare conduit to each area, sized to handle future needs.

3.3 LABELING:

- A. Clearly and properly label the complete electrical system to indicate the loads served or the function of each item of equipment provided under this work.
- B. Nameplates shall be 1/16 inch thick, laminated three-ply plastic, center-ply white, outer-ply black "Lamicoid" or equal. Letters shall be formed by engraving outer black ply, exposing white center-ply, and shall be a minimum of 5/8 inch high. Nameplates shall be secured with screws or pop rivets.

DATC COSMETOLOGY REMODEL

- C. Provide a master nameplate at the main distribution to identify the project, the Engineer and the date. Clearly label switchboards with engraved nameplates to identify each load served.
- D. Label all electrical contactors, relays, time switches, transformers, etc. with an engraved nameplate corresponding to the labeling in the main, subdistribution, or branch panel serving the device or apparatus.
- E. Provide typewritten branch panel schedules with protective clear, transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on drawings.
- F. Identify branch panels with engraved nameplate corresponding with distribution panel labeling. Mount labels inside door for flush panels, and on the face of the door for surface panels. No brand labels or other marking shall be on the outside of the panels. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes.

3.4 SAFETY:

- A. The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the contractor to perform the work.

3.5 DEMOLITION:

- A. It is the intent of these specifications to require the contractor to make all necessary adjustments to the electrical system, required to meet code, and accommodate installation of the new and remodeled work.
- B. Remove all existing fixtures, clocks, switches, receptacles, raceways, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless specifically shown as retained or relocated on the drawings. If existing walls, ceiling, floors, etc. are moved, extend existing devices, fixtures, and circuiting to the new location.
- C. Disconnect all existing mechanical equipment scheduled for removal or relocation. See mechanical drawings for scope of work. Remove abandoned raceways and cables. Relabel panels and motor control centers to reflect changes.
- D. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, new conduit and wire shall be provided to bypass the abandoned outlets. If existing conduits pass through or are mounted on partitions or ceilings which are being removed or remodeled, new conduit and wire shall be provided to route around the ceiling or wall and maintain service to the existing load.
- E. Extend circuiting and devices in all existing walls to be furred out.
- F. Locations of items shown on the drawings as existing are partially based on as-built and other drawings which may contain errors. The Contractor shall verify the correctness of

DATC COSMETOLOGY REMODEL

the information shown prior to bidding and provide such labor and material as is necessary to accomplish the intent of the contract documents. The plans may show some demolition conditions, but are not intended to show all of them.

- G. All materials accumulated during the demolition process are the Owners property and shall be removed from the job site as directed by the Owner. If owner does not wish to salvage materials, contractor shall remove from jobsite and dispose, or recycle materials at contractor's discretion, in a lawful manner.
- H. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes.
- I. Demolish and dispose of hazardous materials in a lawful manner, such as PCB containing transformers or ballasts, mercury containing lamps, or materials containing lead. All costs for proper disposal shall be paid by the contractor unless specified elsewhere in the general conditions.

3.6 POWER INTERRUPTIONS:

- A. Keep outages to occupied areas to a minimum and prearrange all outages with the Owner's representative and utilities involved. Requests for outages shall state the specific dates and hours and the maximum durations, with the outages kept to these specified times. When power interruptions will last longer than 5 minutes and cover more than 10% of the building, or affect public areas, they shall be performed on the weekends between 1 and 5 AM.
- B. Contractor shall coordinate with the Owner so that work can be scheduled not to interrupt operations, normal activities, building access, etc. Coordinate work with other crafts for proper scheduling.
- C. No circuits shall be turned off without prior approval from owner. Coordinate with the Owner any interruptions which affect the operation of the remaining portions of the facility.
- D. This contractor will be liable for any damages resulting from unscheduled outages or for those not confined to the preapproved times. Include all costs for overtime labor as necessary to maintain electrical services in the initial bid proposal. Temporary wiring and facilities, if used, shall be removed and the site left clean before final acceptance. Requests for outages must be submitted at least (5) days prior to intended shutdown time.
- E. Include in bid cost of minimum temporary power for Fire Alarm System, Security, Telephone/Data equipment and any other equipment designated by Owner, during time when primary building power has been interrupted.

3.7 GROUNDING:

- A. Ground all electric equipment, raceways and enclosures in accordance with code rules and established safety practices. Provide a single main grounding point where grounding conductors from the Grounding Electrode System ground rods, ground grids, water pipes, main switchgear, etc. may be terminated.

DATC COSMETOLOGY REMODEL

- B. Concrete encased UFER grounds shall be 2/0 Bare Copper, no less than 40 feet in length. Utilizing rebar for a UFER, although allowed by code, is not acceptable. Bare Copper conductors shall be placed no closer than two inches of the bottom of an exterior wall footing and there shall be no plastic sheeting or other insulating material placed between the footing and earth. Bond to re-bar at minimum 10' intervals.
- C. Grounds shall be installed where accessible for future inspection and servicing. Where ground connections are made underground or in inaccessible locations, they shall be made using an exothermic weld process, Cadweld or equivalent, or Ampact pressure connectors.
- D. Install grounding conductors in approved metallic raceways unless specifically shown or specified otherwise. Bond at each end and at all intervening boxes and enclosures between the service equipment and grounding electrode.
- E. No. 8 and smaller grounding conductors shall have green insulation. No. 6 and larger shall be marked with green colored tape at each end and at every box, panel, switchboard, or point where conductor is accessible.
- F. All isolated ground buses shall be used only for conductors from isolated ground receptacles. Do not bond conduit or enclosures to isolated ground buses. All isolated ground conductors shall be run back to the main ground point for the separately derived system which serves them.

3.8 EQUIPMENT CONNECTIONS:

- A. The location and method for connecting to each item of equipment shall be verified prior to roughing-in. The voltage and phase of each item of equipment shall be checked before connecting. Motor rotations shall be made in the proper direction. Pump motors are not to be test run until liquid is in the system and proper lubrication to all bearings in unit is checked.
- B. Conduit, wire and circuit breaker sizes for mechanical, elevator and similar equipment are based on the equipment ratings of one manufacturer. The equipment actually furnished may have entirely different electrical characteristics. Conduit, wire, circuit breakers, disconnects, etc. shall not be ordered or installed until exact electrical requirements are obtained. Responsibility for this coordination rests with the Contractor.

3.9 SEISMIC BRACING:

- A. Furnish and install all seismic bracing of equipment, feeders, lighting fixtures, and other electrical items in accordance with prevailing codes. Refer to ASCE 7-02, section 9.6 for calculation methods. Provide and submit the required designs, calculations, certifications, and stamped drawings to the authority having jurisdiction and obtain their approval prior to installation or fabrication.
- B. Where conduit, cable trays, or busducts are attached to structures where they cross a seismic isolation interface, the electrical components shall be designed to accommodate the seismic relative displacement.

DATC COSMETOLOGY REMODEL

3.10 PAINTING:

- A. All electrical equipment and conduit exposed in finished areas and on exterior walls are to be painted to match surrounding surfaces.
- B. Contractor shall coordinate the timing of painting requirements.
- C. Refer to Architectural specifications for methods and materials.

3.11 PROJECT RECORD DOCUMENTS:

A. Maintenance of Documents:

- 1. Maintain at Jobsite, One Record Copy of: Contract Drawings, Specifications, Addenda, Reviewed Shop Drawings, Change Orders, Other Modifications to Contract and Field Test Records.
- 2. Keep apart from documents used for construction.
- 3. Keep documents available at all times for inspection by Architect.

B. Recording:

- 1. Label each document "PROJECT RECORD."
- 2. Keep record documents current. Do not permanently conceal any work until required information has been recorded.
- 3. Contract Drawings, legibly mark to record actual construction; including but not limited to the following:
 - a. Depths of various elements; locations of underground items, with dimensions to building walls and corners; changes of dimensions and details; changes made by Addendum, Field Orders or Change Order.
 - b. Specifications and Addenda; Legibly mark each Section to record changes made by Addendum, Field Order or Change Order.

C. As-Built Submittals:

- 1. At completion of project, transfer changes, addenda items, variations from drawings, exact routes of all feeders and service conduits, and locations of stubbed conduits to clean new prints and specifications which will be supplied by the Architect and deliver to the Architect as "As-reported Record" drawings. Include dimensions to all buried or concealed conduits to permanent structures.
- 2. Deliver the revised files on CD or DVD disks, both in AutoCAD (.dwg) and Acrobat Reader (.pdf) formats, together with 1 set of reproducible prints, to Architect as "As-reported Record" drawings.

D. Operation and Maintenance Manuals

DATC COSMETOLOGY REMODEL

1. At completion of project, prepare Operation and Maintenance Manuals with operation and Maintenance Data, contractors warranties, and copies of approved electrical permits. Include corrected copies of original submittals and shop drawings.
2. See Division 1 for additional requirements.

3.12 WARRANTIES:

- A. Provide a minimum 1 year warranty on all electrical equipment, devices, labor, and work by Division 16 whether specified or not.
- B. Provide warranties greater than 1 year as specified in other sections where stated. The warranty requirement most stringent shall be used where conflicts arise.
- C. The systems listed below require warranties exceeding the minimum warranty:
 1. Lighting; 5 years for ballasts refer to Section – 16500
 2. Occupancy Sensed Lighting Control; 5 years refer to Section – 16550.
- D. Provide copies of all warranties to the owner upon completion of the project.

3.13 COMPLETION:

- A. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of faults, shorts or unintentional grounds. Demonstrate system in the presence of the Architect, the Owner or their representative when requested.

3.14 FINAL OBSERVATION:

- A. Contractor shall submit written certification that:
 1. Contract Documents have been reviewed.
 2. Contractor has inspected Project for compliance with Contract Documents.
 3. Work has been completed in accordance with Contract Documents.
 4. Equipment and Systems have been tested and are operational.
 5. Project is completed and ready for final inspection.
- B. Architect will make final inspection as soon as possible after receipt of Certification.
- C. Should Architect consider that work is finally complete in accordance with Contract Document requirements, Contractor shall make Contract Closeout submittals.

DATC COSMETOLOGY REMODEL

- D. Should Architect consider that work is not finally complete:
 - 1. He will so notify Contractor, stating reasons.
 - 2. Contractor shall take immediate steps to remedy deficiencies, and send second written notice to Architect certifying that work is complete.
 - 3. Architect will reinspect work.
- E. The Architect will make two final inspections. The first will determine deficiencies and errors in the work and the second will determine whether or not the noted deficiencies and errors have been satisfactorily corrected.
- F. If additional inspections are required because of the Contractor's failure to complete the deficiencies and errors prior to the second inspection, costs for the successive inspections will be back-charged to the Contractor by the Owner, who, in turn, will reimburse the Architect. Charges will be based as follows:
 - 1. Architect time at current billing rates.
 - 2. Travel time, and all other expenses incurred in making inspections.
- G. Contractor to provide one (1) journeyman, tools, meters, instruments and other test equipment required by Architect. Contractor to remove and replace trims, covers, fixtures, etc., for Architect to review and test materials, systems, methods and workmanship. (Example: Removing switchboard and panel covers to take voltage/amp readings, review connections and wire size, etc.)

END OF SECTION

DATC COSMETOLOGY REMODEL

SECTION 26 0519 – WIRES & CABLES

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all wires and cables as herein specified and shown on the associated drawings.

1.2 QUALITY ASSURANCE:

- A. All wire and cable shall conform to Code and shall meet all ASTM specifications.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. No. 10 and 12 AWG conductors shall be Type "THHN" insulated, stranded or soft drawn solid copper. No. 8 AWG and larger conductors shall be Type "THHN" insulated, soft drawn, Class B stranded copper. Minimum conductor size shall be No. 12 AWG unless otherwise noted.
- B. Where adverse conductor exposure exists, code approved insulation suitable for the conditions encountered shall be used unless shown otherwise on the Drawings.
- C. Wire and cable shall be new, shall have grade of insulation, voltage and manufacturer's name permanently marked on outer covering at regular intervals and shall be delivered in complete coils or reels with identifying size and insulation tags.

2.2 ALUMINUM AND/OR METAL CLAD (MC) CABLING OPTIONS:

- A. Aluminum Not acceptable – Provide Copper Only Feeder Wire.
- B. MC Cable acceptable: Refer to section [26 0520](#) for Metal Clad cabling options.

2.3 COLOR CODE:

- A. All wire shall be fully colored in sizes 12 and 10 AWG, and color banded at each end and at all junction and pull boxes for size 8 AWG and larger.
- B. Color Code throughout the project shall be:
 - 1. 480Y/277V System
 - Phase A Brown
 - Phase B Orange
 - Phase C Yellow
 - Neutral Grey

DATC COSMETOLOGY REMODEL

- | | | |
|----|------------------|---|
| | Equipment Ground | Green |
| 2. | 208Y/120V System | |
| | Phase A | Black |
| | Phase B | Red |
| | Phase C | Blue |
| | Neutral | White |
| | Equipment Ground | Green |
| | Isolated Ground | Green w/yellow stripe #12 & #10
Green and Yellow bands #8 and up |
- C. Provide a permanent, plastic engraved label on the inside of each branch-circuit panelboard throughout the project identifying the Color Code used throughout the project. Refer to NEC 200.6 (D).

PART 3 - EXECUTION

3.1 SPLICES AND TERMINATIONS:

- A. Splices are to be made up complete promptly after wire installation. Single wire pigtails shall be provided for fixture and device connections. Wirenuts may be used for fixture wire connections to single wire circuit conductor pigtails.
- B. Splices shall utilize Scotch "Hyflex" or "Ideal" wing nut connector installed properly. Splices for No. 8 and larger wires shall be made with mechanically applied pressure type connectors. All taped joints shall be with "Scotch 33+" or equal, applied in half-lap layers without stretching to deform.
- C. Insulation shall be removed with a stripping tool designed specifically for that purpose. A pocket knife is not an acceptable tool. All conductors shall be left nick-free.
- D. Thermoplastic insulated wire and cable shall not be installed or handled in temperatures below +14 degrees F (-10 C). Cross-linked polyethylene insulated wire and cable may be installed to -40 degrees F (-40 C).

END OF SECTION

DATC COSMETOLOGY REMODEL

SECTION 26 0533 - RACEWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all raceways, wireways and associated fittings as herein specified and shown on the associated drawings.

1.2 APPLICATION:

- A. Electric metallic tubing (EMT), galvanized rigid conduit (GRC), intermediate metal conduit (IMC), flexible metal conduit, and PVC conduit may be used.
- B. Schedule 40 PVC conduit may only be used below grade and below slabs on grade. PVC may not be used above grade. Conduits larger than 1 inch shall be run below the slab.
- C. GRC and IMC shall be used in locations subject to mechanical injury and for service conduit under buildings or concrete slabs.
- D. EMT may be used only in dry and protected locations.
- E. Flexible metal conduit will be permitted only where flexibility is necessary. Exceptions are connections to recessed light fixtures and work fished into existing concealed dry locations, and wood frame construction. Flexible metal conduit shall be used for connection to all equipment subject to movement or vibration such as motors and transformers.
- F. Drawing notes requiring a specific type of raceway shall take precedence over the specifications.
- G. Surface mounted pancake raceways equal to Wiremold (2600 series unless noted otherwise) may be used only where specifically called for on the drawings or in the specifications. Such installation shall be directed by Architect.
- H. Electrical wiring shall be in U.L. approved raceways and enclosures throughout.
- I. 4" and larger conduits intended for use on primary services and communications services shall have minimum 48" radius sweep on all bends.

PART 2 - PRODUCTS

2.1 FITTINGS:

- A. GRC and IMC shall be coupled and terminated with threaded fittings. Ends shall be bushed with insulating bushings.

DATC COSMETOLOGY REMODEL

- B. Connectors and couplings for EMT shall be steel concrete tight set screw type with insulated throats on connectors. Connectors larger than 1-1/4 inch shall be insulating bushing.

2.2 CONDUIT

- A. Provide EMT in 3/4 inch minimum size.
- B. Provide PVC conduit (where installed below grade or below slab on grade) in one inch minimum size.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Provide pull boxes where shown or required to limit the number of bends in any run to not more than three 90 degree bends. Use code gauge galvanized sheet steel boxes of code required size with removable covers, installed so that covers will be accessible after work is completed. Verify with the Architect any locations in finished areas.
- B. Conceal all wiring in finished spaces. Exposed raceways shall be parallel to structural lines.
- C. Support suspended feeder conduits by metal ring or trapeze hangers with threaded steel rods. If a large number of suspended feeders are grouped together, the contractor shall review the layout with the structural engineer and obtain approval for the proposed layout.
- D. Conduit shall be adequately braced for Seismic Restraint, as required per ASCE 7-02, Section 9.6, latest edition.
- E. Expansion Joints:
 - 1. All conduits crossing expansion joints where cast in concrete shall be provided with expansion-deflection fittings, equivalent to OZ/Gedney AXDX, installed per manufacturers recommendations.
 - 2. All conduits three inches and larger where not cast in concrete shall be rigidly secured to the building structure on opposite sides of a building expansion joint with an expansion-deflection fitting across the joint, equivalent to OZ/Gedney AXDX, installed per manufacturer's recommendations.
 - 3. All conduits less than three inches where not cast in concrete shall be provided with junction boxes securely fastened on both sides of the expansion joint, connected together with 15 inches of slack (a minimum of 15 inches longer than the straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits three inch and larger, may be installed.
- F. Seismic Joints:

DATC COSMETOLOGY REMODEL

1. No conduits cast in concrete shall be allowed to cross a seismic joint.
 2. All conduits shall be provided with junction boxes securely fastened on both sides of the seismic joint, connected together with 15 inches of slack (a minimum of 15 inches longer than the straight line length) flexible conduit and copper green ground bonding jumper. Prior to installation, verify with Architect that the 15 inches is adequate for the designed movement, and if not, increase this length as required.
- G. Conduit stubbed from a concrete slab or wall to serve an outlet under a table or to supply a machine shall have a rigid conduit coupling flush with the surface of the slab. Provide plug where conduit is to be used in future.
- H. Conduits in above grade slabs shall be located in the middle of the slab. The maximum size, spacing, and location of conduits in post-tensioned slabs shall be subject to approval by the structural engineer. Conduits larger than one inch shall not be run in slabs.
- I. Provide a ground wire sized per code in all conduit.
- J. Where PVC conduit is below building slab on grade, conduit must be installed to be at least 2 inches below the slab. Provide 2 inches of sand or pea sized gravel to cover conduit. Protect conduit from vehicle traffic and construction traffic prior to concrete pour. Conduit poured inside the slab for slab on grade construction is not acceptable.
- K. Elbows larger than 30 degrees and one inch shall be galvanized rigid conduit, wrapped with PVC tape.
- L. Provide a ground wire sized per code in all PVC conduits. Conductor quantities indicated in conduits do not include ground wires unless otherwise noted.
- M. Provide trenching, backfilling, compaction, re-paving or other site restoration as required by the work done in this division. Minimum trench depth shall be 24" unless otherwise noted.
- N. Install a detectable 6 inch wide yellow vinyl tape with letter "Caution: Buried Electrical Line Below" 18 inches above all buried service conduit and wire not under structures.
- O. Backfill material for all trenches under paved areas shall be coarse sand or crushed rock, installed in layers not to exceed eight inches and compacted to 95% of maximum density at optimum moisture content to preclude subsequent settlement. Compaction by water method. The top 18 inches of trenches in landscaped or grassed areas shall be backfilled with native soil and tamped.
- P. Conduits piercing a building waterproof membrane shall be provided with flanges, using two neoprene washers, one washer on each side of membrane, between each flange and membrane.
- Q. All underground conduits which enter the building shall be sloped to drain away from the building and shall be water sealed to prevent moisture from passing through the conduit

DATC COSMETOLOGY REMODEL

into the building. All joints to be threaded and taped or glued to prevent entry of water into the conduits.

- R. All underground conduits entering the building shall be poured-in-place, or provided with watertight conduit sleeves and rubber seals, Link-seal system by Thunderline Corporation or equivalent.
- S. Raceways shall be left clean and free of debris.
- T. Provide a pull string in all empty conduits.
- U. All conduit leaving building envelope (e.g. site lighting, roof mounted HVAC requirement, etc.) to be 0.75" minimum.

END OF SECTION

DATC COSMETOLOGY REMODEL

SECTION 26 2726 – SWITCHES & RECEPTACLES

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all switches, receptacles, and other devices as herein specified and shown on the associated drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Bryant, Arrow-Hart, Eagle, LaGrande, General Electric, Leviton, Hubbell are acceptable.

2.2 MATERIALS:

- A. The following list of wiring devices covers the most commonly specified items and establishes the grade of device. Should the Drawings indicate a device other than those listed herein without reference to catalog number, such device shall be of the same grade and manufacturer as like devices.

Single Pole Switches	Hubbell #1221
Duplex Receptacles - 20 amp	Hubbell #5362
Where required by Code and/or indicated on drawings	
Hospital-grade Duplex Receptacle	Hubbell #8300
Safety Duplex Receptacle	Hubbell #HBLSG 63H
Duplex Receptacles-Isolated Ground	Hubbell #5362-IG, Orange
Switch with Pilot	LaGrande #20AC1
Dimmers	Lightolier, Neptune Momentum series

- B. All wiring devices and plates to be specification grade. Receptacles shall be mounted vertically with the ground pin down unless otherwise noted.
- C. Color of devices and plates to be selected by Architect. Provide nylon plates in finish areas. Wood paneled walls shall have brown devices and plates. Restrooms, and food preparation areas to have 302 stainless steel plates. Receptacles fed by emergency circuits shall have red devices with "EMERGENCY POWER" engraved in white letters on a red nylon plate with panel and circuit designation engraved on plate. Receptacles fed by UPS circuits shall have yellow devices with "UPS POWER" engraved in white letters on a red nylon plate with panel and circuit designation engraved on plate.
- D. Flush floor receptacles to be duplex and to have brass, hinged flap lids. Provide carpet flanges in carpeted floors. (See 26 0500, 2.4, E.)

DATC COSMETOLOGY REMODEL

- E. Wet location and/or weatherproof receptacles shall be in a weatherproof enclosure, the integrity of which is not affected when the receptacle is in use (attachment plug cap inserted), UL labeled and listed "Suitable For Wet Locations While In Use". Provide enclosure with stainless steel screws, gasket between enclosure and mounting surface and between cover and base, clear impact resistant UV stabilized polycarbonate as manufactured by TayMac Corporation or accepted equivalent.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Provide a separate GFI type receptacle for each receptacle noted on plans as GFI. Standard receptacles fed from an up-stream GFI type receptacle are not acceptable.
- B. Install outlets and switches in a neat manner.
- C. Extend mudrings to flush out with surrounding wood panels and walls.
- D. Faceplates, devices, and boxes shall be square with floor, and door lines.
- E. Devices to be installed flush with faceplate.

3.2 LABELING:

- A. Where switches control remote lighting or power outlets, or where switches in the same outlet (two or more) serve different purposes, such as light, power, intercom, etc. or different areas, such as corridor and outside, furnish engraved plates with 1/8 inch black letters indicating function of each switch or outlet.

END OF SECTION

DATC COSMETOLOGY REMODEL

SECTION 26 5000 - LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide light fixtures with lamps and accessories as herein specified and shown on the drawings.

1.2 QUALITY ASSURANCE:

- A. If the catalog number of a specified fixture should conflict with the fixture description or the general lighting specifications, such conflicts shall be brought to the attention of the Architect prior to bidding.

1.3 SUBMITTALS:

- A. Submit product data and shop drawings for fixtures, ballasts, and lamps in accordance with the General Conditions, Division 1, and Section 26 0500.
- B. Verify that fixture description matches that which is indicated by the specified catalog number.
- C. All features mentioned in the fixture list shall be marked on the submitted items.
- D. Submit written confirmation that dimming ballasts and dimming controls are compatible.
- E. Submit Operation and Maintenance data in accordance with the General Conditions, Division 1, and Section 26 0500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. See Luminaire Schedule for acceptable manufacturers.
- B. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 1, and Section 26 0500.
- C. Substitution requests for fixtures equal to those specified shall include complete construction and photometric data including, if applicable, candlepower distribution curve, spacing to mounting height ratio, table of coefficients of utilization, isofotcandle curve, ANSI beam spread classification, efficiency, etc.

DATC COSMETOLOGY REMODEL

- D. Submittals and substitution requests for fluorescent fixtures shall include the sheet metal gauge of the housing and the lens thickness, material, and pattern.

2.2 MATERIALS:

- A. Polystyrene lenses and lenses less than 0.125 inches nominal thickness shall not be permitted unless otherwise noted.
- B. Provide luminaires with Area Coverage, damp, or wet label if required for the application indicated.
- C. All recessed luminaires shall be free of light leaks.

2.3 BALLASTS:

- A. All ballasts shall be capable of providing reliable operation of the lamps at the lowest temperature normally encountered. The contractor shall confirm that the ballasts are appropriate for the ambient conditions.
- B. The contractor shall verify the ballast voltage prior to submittal.
- C. Ballasts deemed excessively noisy shall be replaced without cost to the Owner.
- D. STANDARD T8 BALLASTS – RAPID START: T8 rapid start fluorescent ballasts, unless noted otherwise on Light Fixture Schedule, shall be electronic type; ballast data as follows:

- UL listed and CSA certified.
- Full light output.
- Recognized Testing Laboratory listed, thermally protected, resetting, Class P, non-PCB, sound rated A.
- Operate lamps at a frequency of 40KHz or higher with no detectable flicker.
- Total Harmonic Distortion (THD) of 10% or less.
- Full rapid start, and maintain full cathode heat during operation.
- Power factor equal to or greater than 98%.
- Maximum lamp crest factor 1.5.
- Minimum lamp starting temperature of 50 degrees F.
- Meet all current ANSI, IEEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
- Provide normal lamp life as stated by lamp manufacturer.
- Minimum 5 year ballast and replacement labor warranty by manufacturer.
- Ballast manufacturer's data must be included with lighting fixture submittals.
- Compatible with occupancy sensor switching.

Approved manufacturers: Advance, Osram Sylvania, Magnetek, or approved.

- E. DIMMING T8, T5, BIAx, and COMPACT FLUORESCENT BALLASTS – PROGRAMMED START: programmed start dimming fluorescent ballasts, unless noted otherwise on Light Fixture Schedule, shall be electronic type; ballast data as follows:

DATC COSMETOLOGY REMODEL

UL listed and CSA certified.
100% to 5% full range flicker free continuous dimming using 0-10 VDC signal.
Recognized Testing Laboratory listed, thermally protected, resetting, Class P, non-PCB, sound rated A.
Operate lamps at a frequency of 40KHz or higher with no detectable flicker.
Total Harmonic Distortion (THD) of 10% or less.
Power factor equal to or greater than 95%.
Lamp starting at any light output setting.
Meet all current Federal, State and Power Co. efficiency and efficacy standards, and rebate program requirements.
Meet all current ANSI, IEEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
Provide normal lamp life as stated by lamp manufacturer.
Minimum 5 year ballast and replacement labor warranty by manufacturer.
Ballast manufacturer's data must be included with lighting fixture submittals.
Compatible with occupancy sensor switching.

Approved manufacturers: Advance (Mark 10), Lutron, or approved.

Coordinate dimming ballasts with dimming controls specified in separate section.

- F. STANDARD COMPACT FLUORESCENT BALLASTS – PROGRAMMED START:
Compact fluorescent ballasts, unless noted otherwise on Light Fixture Schedule, shall be programmed start electronic type; to operate 4 pin compact fluorescent lamps, ballast data as follows:

UL listed and CSA certified.
Full light output.
Dual voltage rated 120/277
Capable of operating more than one lamp wattage for PL-T triple tube applications
Recognized Testing Laboratory listed, thermally protected, resetting, non-PCB, sound rated A.
Operate lamp(s) at a frequency of above 40 kHz.
Total Harmonic Distortion (THD) of less than 10%.
Programmed start.
Power factor equal to or greater than 98%.
Maximum lamp crest factor 1.7.
Minimum lamp starting temperature of 0 degrees F.
Meet all current Federal, State and Power Company efficiency and efficacy standards, and rebate program requirements.
Meet all current ANSI, IEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
Provide normal lamp life as stated by lamp manufacturer.
Minimum 5 year ballast and replacement labor warranty by manufacturer.
End-of-life detection and shut-down circuitry that meets proposed ANSI/IEC standards.
Ballast manufacturer's data must be included with light fixture submittal.

Approved manufacturers: Advance, Osram Sylvania, Magnetek, Howard Industries, or

DATC COSMETOLOGY REMODEL

approved.

- G. STANDARD T5 and T5HO FLUORESCENT BALLASTS – PROGRAMMED START: T5 and T5HO fluorescent ballasts, unless noted otherwise on Light Fixture Schedule, shall be programmed start electronic type; ballast data as follows:
- UL listed and CSA certified.
 - Full light output.
 - Dual voltage rated 120/277
 - Recognized Testing Laboratory listed, thermally protected, resetting, non-PCB, sound rated A.
 - Operate lamp(s) at a frequency of above 40 kHz.
 - Total Harmonic Distortion (THD) of less than 10%.
 - Programmed start.
 - Power factor equal to or greater than 98%.
 - Maximum lamp crest factor 1.6.
 - Minimum lamp starting temperature of 0 degrees F.
 - Meet all current Federal, State and Power Company efficiency and efficacy standards, and rebate program requirements.
 - Meet all current ANSI, IEE, and FCC regulations for EMI/RFI, harmonic distortion, and transient protection.
 - Provide normal lamp life as stated by lamp manufacturer.
 - Minimum 5 year ballast and replacement labor warranty by manufacturer.
 - End-of-life detection and shut-down circuitry that meets proposed ANSI/IEC standards.
 - Ballast manufacturer's data must be included with light fixture submittal.

Approved manufacturers: Advance Centium, Osram Sylvania, Magnetek, or approved.

- H. Provide emergency battery/inverter packs at fixtures indicated on plans.
1. T8 or T5 fluorescent emergency battery/inverter pack shall be capable of operating lamp(s) at a minimum of 1100 lumens, or at the lumen rating listed on the Light Fixture Schedule (whichever is greater), for a minimum of 90 minutes.
 2. For compact fluorescent or incandescent sources, the emergency battery/inverter pack shall be capable of operating the lamp(s) at 100% lumen rating of the lamp(s) for a minimum of 90 minutes.
 3. Emergency battery/inverter packs shall be UL listed and warranted for a minimum of 5 years for the T8 or T5 lamps and 2 years for the compact fluorescent or incandescent lamps.
 4. Approved Manufacturers: Bodine, Iota, Lithonia or as listed on the fixture schedule.
- I. HID ballasts shall be as follows:
1. High Pressure Sodium (HPS):

DATC COSMETOLOGY REMODEL

- a. High power factor, normal ambient, 180 degrees C insulation class, with capacitor and ignitor.
 - b. Auto transformer type for 50 watt lamps.
 - c. Constant wattage auto transformer type for lamps 70 watt and above.
2. Metal Halide (MH):
- a. High power factor, normal ambient, 180 degrees C insulation class.
 - b. Auto transformer with capacitor and ignitor for lamps 150 watt or less.
 - c. Constant wattage autotransformer with capacitor for lamps above 150 watts.
3. Pulse Start Metal Halide (PSMH):
- a. Where available as standard products, provide pulse start metal halide ballasts for maximum energy savings.
- J. Three or four lamp fluorescent fixtures located within 10 feet of each other, and arranged for 2 or 3 level lighting shall have master/slave ballasts wired in such a manner that a single switch shall not operate the outer lamps in some fixtures, and the inner lamps in others. One ballast shall serve outer lamps and the other shall serve inner lamp(s).
- L. In indoor locations other than dwellings or hazardous locations, fluorescent luminaires that utilize double-ended lamps and contain ballast(s) that can be serviced in place shall have a quick disconnecting means factory installed, internal to the luminaire, and accessible from the ballast housing. The quick disconnect shall simultaneously break all of the supply conductors to the ballast, including the neutral. The line side terminals of the disconnect shall be guarded.

2.4 LAMPS:

- A. Provide standard grade, T8 lamps, low mercury TCLP compliant (green ends), 2850 minimum lumens, 3500°K CRI of 75.
- B. T5, Biaxial, and compact fluorescent lamps shall be 3500°K type with a minimum CRI of 82, unless otherwise noted. Provide low mercury TCLP compliant lamps (green ends) where available as standard products (Philips Alto series or equal).
- C. Metal Halide high intensity discharge lamps shall be either coated or clear as recommended by the fixture manufacturer. Provide pulse start lamps for Metal Halide fixtures requiring pulse start. Provide minimum CRI of 65.

DATC COSMETOLOGY REMODEL

- D. Provide Ceramic Metal Halide (Philips Master Color) with minimum CRI of 80 for display type lamps. Provide Low mercury TCLP compliant (green end) where available as standard product.
- E. For Metal Halide lamps, provide Base Up, or Horizontal rated lamps for maximum lumen output. Universal Burn lamps are not acceptable.
- F. High Pressure Sodium high intensity discharge lamps shall be low mercury TCLP compliant where available as standard products, and have an average rated life of 24,000 hours.
- G. All incandescent lamps shall be 130 volt, inside frosted unless otherwise noted (except Halogen).
- H. Acceptable lamp manufacturers are Venture, Osram/Sylvania, Philips, and General Electric.
- I. All lamps and fixtures shall be in proper operation at the time of acceptance.
- J. SPARE LAMPS: Provide ten percent spare lamps, with a minimum of two, for each size and type used.

2.5 POLES:

- A. Each pole shall have adequate strength and rigidity to withstand not less than 100 mph winds without damage to the poles and attached fixtures and lamps. Pole bases shall be equipped with handholes with matching covers, and base cover.
- B. Anchor bolts shall be hot-dip galvanized after fabrication and threads cleared. Nuts, washers, and other hardware and fittings shall be corrosion resistant alloy material of adequate strength. Indicated pole heights are above the top of the concrete base.
- C. After the poles have been installed, shimmed and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material.
- D. Provide ground rod for poles installed on grade, attached to pole.
- E. Provide fuse clips located in handhole for each fixture head circuit.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Luminaires installed under this work shall be properly and adequately supported from the building structure except where ceiling construction or other provisions are specifically designed to support the fixture units. Fixture support systems shall provide a safety factor of four. This shall apply to chains, hangers, anchors, clamps, screws, and all other hardware and appurtenances associated with the support system.

DATC COSMETOLOGY REMODEL

- B. Fixture supports shall provide proper alignment and leveling of fixtures, and shall be arranged to maintain the alignment at all times. The final decision as to adequacy of alignment shall be given by the Architect.
- C. All light outlets shall be supplied with a fixture. Outlet symbols on the drawings without a type designation shall have a fixture the same as those used in similar or like locations.
- D. Fixture stem or chain lengths for industrial reflector or bare lamp strip fixtures shall be appropriate for the space and for coordination with other work such as ducts and piping. Provide swivel hangers for stem-hung fixtures.
- E. Fixtures shall be left clean at the time of acceptance of the work and every lamp shall be in operation. The responsibility for cleaning or protecting fixtures from dirt, dust, paint, debris, etc. shall rest with the Contractor performing this division of work.
- F. Prior to the purchase of any luminaire, the finish shall be verified with the Architect and the voltage shall be verified based on the panelboard voltage.
- G. Fixtures of a given description may be used in more than one type of ceiling. Consult the Architectural Reflected Ceiling plan to obtain this information. Some ceiling types may have changed immediately prior to bidding or by addenda or change order and the changes may not be reflected in the fixture list or fixture designations as shown on the plans. The contractor shall compare the electrical plans with the reflected ceiling plan and confirm that the specified fixtures are compatible with the ceiling system prior to ordering.
- H. Provide seismic support wires for all recessed fixtures where ceiling framing is not designed for fixture support.
- I. Provide all recessed lay-in fixtures a flexible power whip of at least 48 inches but not exceeding 72 inches. Where using modular wiring systems, wiring shall be supported from structure, not laying on ceiling tiles.
- J. Where fixtures are mounted under cabinets, in soffits, coves, or other physically restricting spaces, the contractor shall verify that the fixtures will fit the space prior to ordering.
- K. Undercabinet and similar fixtures are to be hard wired. Flexible cords similar to SO cord are not acceptable.
- L. Air supply fixtures shall be supplied with pattern control vanes.
- M. See Architectural plans for fire rated ceilings and coordinate fixture installation with general contractor to assure continuity of fire rating.
- N. Do not mount fluorescent or H.I.D. fixtures within 12" of any cable tray or telecommunications cable.

DATC COSMETOLOGY REMODEL

- O. Where dimming systems are specified, contractor shall operate fixtures at full intensity for a minimum of 100 hours prior to testing. Lamps shall not be dimmed until the 100 hours is complete.

END OF SECTION

DATC COSMETOLOGY REMODEL

SECTION 26111 – SURFACE RACEWAY SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. The Basic Electrical Materials and Methods, Section 16050, are a part of this Section as though set forth herein.
- B. Examine other sections of Division 26 and ascertain their effect upon, and relationship to the work in this Section. Provide the products and execute the work for this Section in accordance with the product and execution requirements, where applicable, as set forth in other sections of Division 26, to provide an interrelated electrical system.
- C. Furnish and install all labor and material required for a surface raceway system for standard receptacles to include receptacles, devices, supports, fittings and accessories necessary to complete the installations indicated.
- D. Submit Shop Drawings of the complete system. Shop Drawings shall include sizes and lengths of raceways as verified with laboratory furniture Shop Drawings, inside corners, outside corners, end caps, raceway cover spacings, grounding, branch circuiting and wiring including locations of service entrances, receptacle types and manufacturers, receptacle spacings, receptacle labeling with proper voltage, phase, circuit and panelboard designations as indicated on the drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Raceways to be field assembled complete including bases, covers, end plates, wiring, receptacles, fittings and connections, to exact lengths to match the lengths shown on electrical drawings. Field measure all dimensions prior to installation. All receptacle circuits to be wired for the entire length of the section, leaving 2' pigtail for field connection. Tap splicing of wires shall be done using "Scotch-lok" self-stripping electrical tap connectors No. 562.
- B. Raceway Type A shall be Wiremold Series 2600.

PART 3 - EXECUTION

3.1 GENERAL

DATC COSMETOLOGY REMODEL

- A. Raceways Type A to receive receptacles of type, quantity and spacing as indicated on Plans.
- B. Raceways to be mounted on walls and casework parallel to or at right angles to structure and casework.
- C. The number of conductors installed in any raceway shall not be greater than the number for which the raceway is approved.
- D. Ground continuity shall be maintained throughout the entire raceway length by means of factory installed separate insulated Code-size grounding conductors.

END OF SECTION

DATC COSMETOLOGY REMODEL

SECTION 26122 – METAL CLAD CABLE

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Metal Clad cable may be used for concealed branch circuit wiring where permitted by local codes and the National Electrical Code, except where otherwise noted.

1.2 USES PERMITTED:

- A. Metal Clad cable shall only be used for concealed branch circuit interior wiring and may be exposed only in unfinished crawl spaces or above T-bar ceilings. It shall not be used in inaccessible ceiling areas or insulated walls.
- B. Metal Clad cable shall not be used for branch circuit home runs. Home runs shall be installed using conduit and conductor method from the circuit breaker panel to a junction box in the accessible ceiling above a room or adjacent to the room if that room's ceiling space is inaccessible. From the accessible area junction box, Metal Clad cable may be used to each device or light fixture.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Cable shall be steel or aluminum (steel only, in Healthcare Facilities) jacketed interlocking armor with internal fully insulated green grounding conductor. Cable shall contain multi-conductor thermoplastic insulated type THHN color coded solid or stranded copper conductors and shall be U.L. approved for the intended application.
- B. Connections, terminations and fasteners shall be U.L. approved for the application, and designed specifically for use with the cable used, and shall have insulated throats to protect the wire.

2.2 APPROVED MANUFACTURERS:

- A. MC Cable: AFC/A Nortek Company, Type Mc-Lite, HC-90; Alflec, Armorlite.
- B. Tools: Cable manufacturer approved type with controlled depth rotary cutter.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Support horizontal and vertical cable 6 feet on center (maximum) and within 6 inches of boxes with approved cable clamps.

DATC COSMETOLOGY REMODEL

- B. Support cable above accessible ceilings; do not rest cables on ceiling tiles. Attach cables with metal clips or plastic cable ties to support wires from structure on 6 foot centers maximum.
- C. Cable shall be cut with manufacturer approved devices.
- D. Splice conductors only in accessible junction boxes.
- E. Cable shall not be supported from, or come in contact with, mechanical ducts, water, sprinkler or gas piping; maintain 6 inch separation minimum.
- F. Provide junction box at all cable penetrations of wall, ceiling or floor surfaces for equipment connections; cable shall not be run directly through finished surfaces.
- G. Voltage drop: Conductors over 75 feet for 120 volt, and over 200 feet for 277 volt, for branch or individual circuit home runs from equipment connection, receptacle or lighting fixture shall be No. 10 AWG minimum.
- H. Provide junction box at transition from concealed to exposed wiring. Exposed wiring shall conform to Section 16130 - Raceways.
- I. Where cable penetrates fire-rated walls or floors, provide mechanical fire stop fitting with UL listed fire rating equal to wall or floor rating.
- J. Provide junction box at transition from interior to exterior wiring. Exterior wiring shall conform to Section 16130 - Raceways.

END OF SECTION

DATC COSMETOLOGY REMODEL

SECTION 26723 – FIRE ALARM SYSTEMS (EXISTING)

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. The Contractor shall furnish and install fire alarm devices, as specified herein and indicated on the drawings.
- B. Provide all signal initiating devices, audible and visual alarm devices, power supply, a wiring system, and all accessory devices required to provide a complete operating system.
- C. All components shall be compatible with the existing system.
- D. The system shall comply with the applicable provisions of the National Alarm Code (NFPA 72), Americans with Disabilities Act, and meet all requirements of the local authorities having jurisdiction. All equipment and devices shall be listed by the Underwriter's Laboratories, Inc., or approved by the Factory Mutual Laboratories.
- E. Add additional expansion components to the existing fire alarm panel and system as required to accommodate new initiating and warning devices which are being added to the system (detectors, call stations, strobes, horns, tamper switches, door holders, etc.)

1.2 SUBMITTALS:

- A. Submit complete and descriptive shop drawings in accordance with Section 01300.
- B. Submit plans and specifications to the governing Building Official. Obtain his written acceptance of, and procure and pay for all permits for, the system prior to beginning work and ordering equipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Match existing system Manufacturer. No substitutions.
- B. Arrange for the fire alarm system vendor to review the wiring and power supply capacity of the existing system. Increase the power supply capacity, signal circuit wire size, or add a remote power supply as needed to accomplish proper operation of the system.

PART 3 - EXECUTION

3.1 WIRING:

DATC COSMETOLOGY REMODEL

- A. Furnish and install all required wiring in accordance with local and National codes.
- B. Unless otherwise specified, minimum wire size shall be 16 gauge for audible alarm circuits, and 18 gauge for signal initiating circuits. # All wiring shall be in conduit. Conduit shall be sized by the contractor. #See 16050 for wiring methods.
- C. Refer to mechanical drawings for quantity, location and type of device to be connected to the fire alarm system. Duct smoke detectors, sprinkler flow and tamper switches furnished and installed under Division 25 shall be connected by Division 26. Provide additional zone modules in existing FA control panel if required by code for devices provided under Division 25. Provide a 120 volt, 20 amp branch circuit at each duct smoke detector shown on mechanical drawings.
- D. Confirm that the existing power supply and circuiting have sufficient capacity to handle additional horns and strobes. If insufficient capacity exists, add additional components to resolve the problem. This might include such items as replacing existing signal circuits with larger wire or replacing power supplies. All signal devices must operate properly at completion.

3.2 DEVICE LOCATION

- A. Install smoke and heat detectors a minimum of 3 feet away from air supply and return diffusers. Install smoke or heat detectors in sloped ceilings to within 3 feet of the top of the sloped structure.
- B. Install smoke and heat detectors in locations as approved by the NFPA 72. Adjust locations as required to coordinate with solid beam construction, peaked or sloped ceilings, and high ceiling areas.
- C. Smoke detectors installed in corridors shall be no more than 30 feet on center, and 15 feet from the end of the hallway. Pullstations shall be located not more than 15 feet from end of the hallway. Strobes and speaker/strobes shall not be located more than 15 feet from the end of a hallway or change in corridor direction.
- D. Consult Engineer for minor relocations of devices that may be required to avoid obstructions, or for ease of installation or concealment. Mark all such relocations on record drawings. Contractor shall relocate devices up to 15 feet without any additional charge to the contract.

3.3 FIELD QUALITY CONTROL:

- A. A factory trained representative of the manufacturer shall supervise the prefinal testing of the system. Pretest all installed devices to ensure compliance prior to the final test.
- B. The final test shall be subject to the approval and acceptance of the responsible Architect/Engineer, and the Fire Marshal. Provide all appropriate equipment to complete the testing.
- C. On completion of the acceptance tests, the Owner or his representative shall be instructed in the operation and testing of the system.

DATC COSMETOLOGY REMODEL

3.4 CERTIFICATION/CLOSEOUT:

- A. Submit a statement to the Architect/Engineer that indicates the system has been designed, tested, and installed in accordance with all applicable codes and regulations.
- B. Submit diskette or CD, with all appropriate programming updates to the owner.
- C. Submit testing report to the Architect/Engineer and Fire Marshal showing results of tests.
- D. Submit letter of warranty, guaranteeing the new portion of the fire alarm system for 1 years. Provide a 24 hour response upon failure of any component of the fire alarm system. The vendor, and the contractor, are required to participate as necessary for any warranty work during the warranty period.

END OF SECTION

DATC COSMETOLOGY REMODEL

SECTION 26950 – OCCUPANCY SENSED LIGHTING CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. The Contractor shall provide all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.
- B. The Contractor shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.

1.2 SUBMITTALS:

- A. Submit complete and descriptive shop drawings including floor plans, layouts, catalog cuts and other descriptive data indicating compliance with the specifications herein. Submit data sheets on sensors, control units and all junction boxes and mounting accessories, including all wiring diagrams. Submit in accordance with Section 01300.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. The Watt Stopper, Inc., Mytech/Hubbell, Leviton, Novitas
- B. Requests for substitution of other products will be considered if submitted in accordance with the general conditions and Division 1.
- C. All sensors shall be California Energy Commission Title 24 approved and certified.

2.2 WALL SWITCH INFRARED TYPE (For Offices up to 150 square feet).

- A. Wall switch sensors shall be capable of detection of motion at desk top level up to 500 square feet.
- B. Wall switch sensors shall accommodate loads indicated on the plans.
- C. Coverage of 180 degrees
- D. Digital auto-OFF time delay adjustable from 30 seconds up to 30 minutes.
- E. Adjustable unit sensitivity.
- F. Integrated light level sensor - works from 2.4 to 300 footcandles

OCCUPANCY SENSED LIGHTING CONTROL

DATC COSMETOLOGY REMODEL

- G. LED for sensitivity calibration
- H. Transformer / latching relay design.
- I. Works with electronic ballast and high power factor PL lamp ballasts.
- J. No leakage current in off mode.
- K. Voltage drop protection.
- L. Watt Stopper Model WS 120 / 277

2.3 CEILING MOUNT INFRARED TYPE (For offices up to 300 square feet)

- A. Shall utilize custom ASIC specifically designed for PIR occupancy sensors which provides high immunity to RFI and EMI.
- B. Shall have user-adjustable sensitivity setting and adjustable time delay of 30 seconds to 30 minutes.
- C. Shall have in place a by-pass pin which when removed will override sensor to ON and which requires no rewiring or modification to unit.
- D. Shall have a daylight filter which insures that the sensor is insensitive to short-wavelength infrared waves such as those emitted by the sun.
- E. Shall have the ability to sense directly under and slightly behind sensor when mounted on ceiling.
- F. Shall not protrude more than 1 1/4 inches from the ceiling (or wall).
- G. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering of adjustments and hardware.
- H. Shall operate from a 24 volts DC power supply: current draw of 14 milliamps.
- I. Watt Stopper Model WPIR

2.4 CEILING MOUNT INFRARED TYPE (For Offices, Conferences Rooms up to 900 square feet).

- A. Shall use custom ASIC specifically designed for PIR occupancy sensors which provides high immunity to RFI and EMI.
- B. Shall have two outputs; one output is based on occupancy only and one is based on occupancy with a hold OFF and an internal photocell setting when a minimum light level is present (adjustable from 3 to 200 footcandles).
- C. Shall have a digital time delay setting adjustable from 15 seconds to 30 minutes.
- D. Shall be furnished with a DIP switch override-ON function for use in the event of failure.

OCCUPANCY SENSED LIGHTING CONTROL

DATC COSMETOLOGY REMODEL

- E. Shall have an additional single pole, double throw isolated relay with normally open, normally closed, and common outputs rated at 1 Amp for 24 VDC. The isolated relay is for use with HVAC control, data logging, and other control options.
- F. Shall have a standard 30 element Fresnel lens with 15 layers horizontally and 4 layers vertically, a 14 element Long Range Fresnel lens with 9 layers horizontally and 4 layers vertically, or an Aisle Way Fresnel lens with 14 layers horizontally and 9 layers vertically.
- G. Shall cover up to 1200 square feet with the Standard Lens, up to 90 linear feet with the Long Range Lens, and up to 120 linear feet with the Aisle Way Lens for walking motion when mounted at a ceiling height of 12 feet.
- H. Shall operate on 24 VDC, current draw of 19 Ma.
- I. Watt Stopper Model CX-100

2.5 CEILING MOUNT ULTRASONIC TYPE (For Restrooms, Open Office Areas up to 1000 square feet)

- A. Shall be omni-directional with volumetric coverage of 360 degrees and up to 1000 square feet of walking motion.
- B. Shall have a multi-direction transmitter with temperature and humidity resistant, minimum 32 kHz tuned ultrasonic receivers. Ultrasonic receivers shall be temperature and humidity resistant with less than a 6dB shift in the humidity range of 10% to 90% and less than a 10dB shift in the temperature range of -20 to 60 degrees C.
- C. Sensors of varying frequencies shall not be allowed so as to prevent sensors from interfering with each other and to ensure compatibility in the event more sensors are added or units are replaced.
- D. Shall be furnished with a convenient shunt provision which will enable a by-pass in the event of failure. This by-pass provision pin shall remain in the sensor and be visible from the floor as a constant reminder that the automatic function has been by-passed.
- E. Shall have user-adjustable sensitivity setting and time delay setting from 15 seconds to 15 minutes.
- F. Shall operate on 24 VDC, current draw of 15 mA.
- G. Watt Stopper Model W-1000A

2.6 CEILING MOUNT DUAL-TECHNOLOGY TYPE (For Rooms up to 1200 SF)

Low Profile, ceiling mount, 360 degree coverage:
Adjustable arm, wall mount, 180 degree coverage:

Watt Stopper Model DT-300
WattStopper Model DT-200

DATC COSMETOLOGY REMODEL

- A. The Occupancy Sensors shall be capable of detecting presence in the floor area to be controlled, by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes (dual technology). Sensors that utilize microphonics are not approved.
- B. Upon entering a space, motion from both technologies must be sensed before lighting will be turned on. After this has occurred, detection in either technology will hold lighting on for the set time period. Sensors will have a retrigger time delay where only one motion is necessary to turn on the lights within 5 seconds after turning off.
- C. Ultrasonic sensors will be volumetric in coverage. Up to 10 different passive infrared patterns will be available by lens selection. Detection shall be maintained when a person of average size and weight moves only within or a maximum distance of twelve inches either in a horizontal or vertical manner at the approximate speed of 12 inches per second. The sum of this distance, volume and speed represent the average condition an Occupancy Sensor must meet in order that the lights will not go off when a person is reading or writing while seated at a desk.
- D. Sensors will cover a minimum of 1500 square feet when mounted at 12 feet.
- E. The sensors are designed to be ceiling mounted and not protrude more than 2 inches and should blend in aesthetically with the space.
- F. Each sensing technology shall have independent sensitivity adjustments and LED display.
- G. Time Delay range shall be adjustable from 15 seconds to 15 minutes.
- H. Sensors shall operate on 24 volts, 25 milliamps DC.
- I. Sensor shall have an additional single pole, double throw isolated relay with Normally Open, Normally Closed and Common outputs rated at 1 amp for 24 VDC. The isolated relay is for use with HVAC control, Data Logging, and other control options.
- J. Ultrasonic circuit shall be solid state, crystal controlled with signal processing filtering.
- K. Ultrasonic receivers shall be temperature and humidity resistant with less than a 6dB shift in the humidity range of 10% to 90% and less than a 6dB shift in the temperature range of -20o to 60o C.
- L. The ultrasonic frequency shall be 40 kHz + .006%.
- M. Ceiling mount sensors shall provide a minor motion coverage range of 250 to 1300 square feet with an overall 1/2 step coverage range from 500 to 2000 square feet.
- N. All sensors shall be capable of operating normally with electronic ballast and PL lamp systems.
- O. All sensors shall be self-contained, crystal controlled ultrasonic or infrared occupancy sensors located to provide coverage of 90 to 100% of the controlled area.

DATC COSMETOLOGY REMODEL

- P. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- Q. All sensors shall have readily accessible, user adjustable controls for time delay and sensitivity. Controls shall be recessed in the sensor to limit tampering.
- R. In the event of failure, a bypass manual "override on" shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed in the sensor to prevent tampering.
- S. Ultrasonic operating frequency shall be crystal controlled to within plus or minus 0.005% tolerance to assure reliable performance.
- T. Ultrasonic microphone receiver frequency shall be 25 KHz or greater and shall be temperature and humidity resistant.
 - 1. All sensors shall provide a red LED indication light to verify that motion is being detected and that the unit is working.
- U. All ultrasonic sensors shall comply with the State of California Safety and Health Requirements. Decibel levels for ultrasonic sensors shall comply with the following California Energy Commission criteria:

Midfrequency of Sound Pressure Third Octave	Minimum dB level within Third Octave Band (in dB Band (KHz) reference 20 micropascals)
Less than 20	80
20 or more to less than 25	105
25 or more to less than 31.5	110
31.5 or more	115

The Contractor shall certify in writing that installed sensors comply with the specified California Energy Commission criteria for ultrasonic sound.
- V. All sensors shall have no leakage current in OFF mode and shall have voltage drop protection.
- W. Sensors shall be suitable for N.E.C. 725 Class 2 wiring and use plenum cable where approved. Where plenum cable is not approved, provide conduit to within 6 inches of sensor location.

2.7 POWER PACKS:

- A. Power Packs shall be mounted on external J boxes and be an integrated self-contained unit consisting of a load switching relay and a transformer.
- B. Relay Contacts shall have ratings of:

DATC COSMETOLOGY REMODEL

10A - 120 VAC Tungsten
20A - 120 VAC Ballast
15A - 277 VAC Ballast

- C. Relay contacts shall be isolated.
- D. Power Packs: Wattstopper A-120E, A-277E
- E. Between sensors and controls units shall be three (3) conductors, 18 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable approved for use in plenums. One sensor shall be capable of driving four Power Packs.
- F. Enclosures for Power Packs shall be NEMA I construction with mounting and barriers to provide separation between line and low voltage wiring or a standard four (4") inch junction box with control unit mounting to cover plate with ½ inch knockout. Boxes not located above accessible ceilings shall be painted to match finish color of mounting surface.
- G. Occupancy sensors shall have calibration at the occupancy sensor head, not at the power pack above the ceiling.

PART 3 - EXECUTION

3.1 PERFORMANCE:

- A. The objective of this section is to ensure the proper design and installation of the occupancy sensor based fluorescent lighting control system in rooms designated on the drawings so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.
- B. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

3.2 DESIGN:

- A. It shall be the contractor's responsibility to contact the Manufacturers Representative and, with their assistance, aim and locate sensors correctly as required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas. Rooms shall have ninety (90) to one hundred (100) percent coverage to adequately cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the rooms(s). The sensor symbols shown on the drawings are diagrammatic and indicate only rooms which are to be provided with sensors. The contractor shall provide sensors as required to properly and completely cover the respective room. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. Sensors in small offices should be located to avoid false operation caused by persons walking by the door and outside the office.

DATC COSMETOLOGY REMODEL

- B. Mount occupancy sensors a minimum of 8 feet away from HVAC diffusers. Ultrasonic sensors shall be mounted on vibration free, stable surfaces and shall not be used in areas of heavy air flow, moving objects, or on ceilings over 14 feet high.
- C. Where "override-OFF" switch is required, switch is to be connected on the load side of the Power Pack Relay.

3.3 WARRANTY:

- A. Contractor shall warrant the system including all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The suppliers obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. Warranty on sensors and controls units will be for a period of five (5) years. The warranty shall commence upon the owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

3.4 OWNER TRAINING:

- A. The contractor shall provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

END OF SECTION

DATC COSMETOLOGY REMODEL

SECTION 27 0500 – VOICE AND DATA WIRING

PART 1-GENERAL

1.1 WORK INCLUDED:

- A. Furnish and install all labor and materials required for the installation of a complete voice and data cable infrastructure.

1.2 QUALITY ASSURANCE:

- A. Do all work in accordance with the guidelines published in EIA/TIA standard 568 and 569. Where conflicts exist, the plans and specifications shall generally take precedence. Bring all such conflicts to the attention of the Architect for final resolution.
- B. All workers involved in the installation and termination of cable shall have at least one year of experience. All workmen on the job shall have attended a vendor sponsored training program covering installation and termination of cable.

1.3 SUBMITTALS:

- A. Submit complete and descriptive shop drawings in accordance with Division 1, and General Conditions. Include data for wall jacks, cable, racks, patch panels, and a layout for each IDF and MDF terminal board.
- B. Submit floor plans indicating the boundaries for the area served by each IDF location. Clearly identify the boundaries on the as-built plans.

1.4 GUARANTEE:

- A. Guarantee all work against faulty and improper material and workmanship for a minimum period of one (1) year from the date of final written acceptance by Owner, except where guarantee or warranties for longer terms are specified herein.
- B. The warranty shall assure that all components, links, and channels shall equal or exceed the EIA/TIA standards including attenuation, NEXT, etc. for the duration of the warranty.
- C. Acceptable warranty providers are as follows.
Comscope/Systemax
Belden/Nordex
Siemens/Mohawk
Leviton/Superior Essex
- D. Upon notification of a problem, the warranty provider shall furnish within 48 hours and at no cost to the owner, such labor and materials as are needed to restore the system to proper operation.

DATC COSMETOLOGY REMODEL

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. The structured cable system and all of its components and installation shall meet the requirements of the latest draft of the EIA/TIA performance standards for the category of cable and accessories specified elsewhere in this specification.
- B. All components shall be backwards compatible. They shall satisfy all requirements of their category in addition to all existing lower category specifications.

2.2 ACCEPTABLE MANUFACTURERS:

- A. Structured Cabling and Outlet Solutions:
 - Comscope/Systemax
 - Belden/Nordex
 - Siemens/Mohawk
 - Leviton/Superior Essex
- B. Equipment Racks: Hubbell, Chatsworth, Homaco, Ortronics
- C. Ladder Tray: Hubbell, Chatsworth, Homaco, Ortronics
- D. Requests for substitution of other products will be considered if submitted in accordance with the General Conditions, Division 1, and Section 16050.

2.3 FIBER BACKBONE:

- A. All fiber optic cable shall be single or multimode as indicated on the drawings, and shall meet the requirement of ANSI/EIA/TIA-568 for optical fiber backbone cable.
- B. Multimode cable shall be 62.5 micron graded index fiber with a bandwidth of no less than 500 mhz/km at 1300 nm, 200 mhz/km at 850 nm, and attenuation not exceeding 1 db at 1300nm and 3 db at 850nm. Fiber shall be guaranteed for gigabit Ethernet performance at distances up to 500 meters at 850 nm, and 1000 meters at 1300 nm.
- C. Single mode cable shall be 8 micron step index fiber with attenuation no greater than 0.5 db/km for 1310nm.
- D. Terminate all fiber strands with type ST connectors unless noted otherwise.
- E. All fiber cables terminating in IDF locations shall be terminated in wall or rack mount patch panels. Patch panels shall be loaded with the correct quantity of connector couplings.
- F. All fiber optic patch cords will be furnished and installed by the Owner.
- G. All fiber backbone cable shall be run in innerduct.

DATC COSMETOLOGY REMODEL

2.4 COPPER BACKBONE:

- A. All outdoor backbone/riser cable shall be multi-paired cable, consisting of 24AWG thermoplastic insulated conductors formed into binder groups of 25 pairs. Core to be flooded with gelled filling compound for water resistance. Cable must have overall shield/sheath of aluminum and steel with an outer jacket of polyethylene. The cable shall meet the requirements for Category 3 horizontal UTP cable of EIA/TIA/ TSB-36 and ANSI/EIA/TIA-568 for 100-ohm UTP multi pair backbone cable.
- B. 110 type protection blocks with solid state over-voltage protection and sneak current protection for terminating outdoor twisted pair cable shall be installed in the building entrance terminal. Blocks shall be complete with mounting hardware, protection modules, connecting blocks, retainers, wire management, designation strips, etc. Must be UL listed. Protection units shall be equipped with stub cable for splicing to the building entrance cables.
- C. All indoor backbone/riser cable shall be multi-paired cable, consisting of 24AWG thermoplastic insulated conductors formed into binder groups of 25 pairs. Cable must be riser rated and meet the requirements of ANSI/EIA/TIA-568 for 100-ohm UTP multipair Backbone Cable.
- D. Rack mount wire management panels are to be installed between each pair of 48 jack rack mount 110 type modular patch panels.
- E. Provide minimum 2" wide horizontal slotted wall duct between rows of 110 blocks.

2.5 CABLE SCHEDULE:

- A. The following riser and backbone cables shall be installed and terminated.

COUNT	TYPE	FROM	TO
1	100 pr riser	Telecom Rm 104	Telecom Rm 290
1		Splice Case	Protection blocks
1	100 pr	Protection blocks	Telecom Rm 104 Cross Connect
10	4 pr utp	MDF	IDF
12 str	MM fiber	MDF	IDF

2.6 HORIZONTAL COPPER DISTRIBUTION

- A. All UTP cable shall be 4-pair cable, of 24AWG solid copper conductors under a common sheath. Cable must meet the requirement for Category 6 of EIA/TIA standards and be rated for use in the environment in which it is used.
- B. ■Voice and ■ Data■ UTP cables shall terminate on rack mount 110-type UTP terminating Category 6 modular RJ-45 patch panels and shall be provided and installed in equipment racks. They must meet requirements for Category 6 of EIA/TIA TSB-40. Rack mount wire management panels are to be installed for each 48 jack rack mount patch panel.

DATC COSMETOLOGY REMODEL

- C. All voice and data outlet plates shall be of a modular design capable of accepting interchangeable RJ-11, RJ-45, video F connectors, BNC, fiber ST, SC, or MT-RJ connectors, or blank inserts into a single plate. Inserts shall be designed to permit them to be disconnected from the plate without removing the cable, and reinstalled on another plate. Plates shall be single gang nylon, color to match adjacent power receptacle plates.
- D. All plates shall be 4 port with quantity of jacks as indicated elsewhere. Provide blank fillers in all unused ports.
- E. Each outlet shall have UTP cables terminated on CAT 6 RJ-45 jacks. Provide two jacks per plate except as indicated otherwise on the floor plans by a numeric designation adjacent to the outlet symbols.
- F. Each outlet shall have two UTP cables terminated on two CAT 6 RJ-45 jacks. The jacks shall be designated A and B, with the top, or "A" jack being used for voice and the "B" jack assigned to data. The data jack shall be orange in color and the voice jack will match the plate color.
- G. Wireless LAN and telemetry transceivers shall be wired per manufacturer's recommendations with 4 pr CAT 6 UTP. Wireless phone transceivers shall be wired per manufacturer's recommendations with 2 pr CAT 3 UTP. Leave 10 feet of slack at all wireless transceiver locations.
- H. Wall phone outlets shall have one 4 pair UTP cable terminated in a single gang plate.
- I. Wiring configuration (568A 568B) as directed by Owner.

2.7 HORIZONTAL FIBER CABLE

- A. All horizontal fiber optic cable shall be single or multimode as indicated on the drawings, and shall meet the requirement of ANSI/EIA/TIA-568 for optical fiber cable.
- B. Multimode cable shall be 62.5 micron graded index fiber with a bandwidth of no less than 500 mhz/km and attenuation not exceeding 1 db at 1300nm and 3.5 db at 850nm.
- C. Single mode cable shall be 8 micron step index fiber with attenuation no greater than 0.5 db/km for 1300nm.
- D. Terminate all fiber strands with type ST connectors unless noted otherwise. Plates shall be as described in the preceding section titled "Horizontal Copper Distribution".
- E. All fiber cables terminating in IDF locations shall be terminated in wall or rack mount patch panels. Patch panels shall be loaded with the correct quantity of connector couplings.

2.8 EQUIPMENT RACKS:

- A. Unless otherwise noted, racks shall be free standing 7'X19" unless a different height is specified on the drawings. All aluminum bolt down EIA standard equipment rack, with 1-1/4" X 1/2" front and rear flange hole pattern, 12-24 threaded holes, brushed aluminum

DATC COSMETOLOGY REMODEL

finish, and self support base. Wall mount racks may be used only where specifically called out on the drawings.

- B. Provide 6" wide double sided vertical wire management section between racks and on each end.
- C. No more than 60 percent of the vertical space in any rack may be utilized. The bottom part shall be left for future expansion or Owner equipment.

2.9 LADDER TRAY:

- A. Where indicated on the plans, ladder bottom type cable tray is to be installed in each telecommunication room. Coordinate the installation of tray with all other construction within the telecommunications room.
- B. Channel type; steel; painted telephone equipment gray; complete with all necessary hardware and fittings for a complete installation; capable of supporting a cable load of a least 50 pounds per linear foot with side rail deflection not to exceed 0.5 inch at this load. Size as indicated.
- C. Trays shall be attached to tops of equipment racks where they pass over them. Cable tray to be firmly attached per the manufacturers instructions. Provide cable dropouts at locations where 5 or more cables will exit the tray.
- D. Provide seismic bracing acceptable to the code authorities having jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. The Contractor shall furnish and install all cabling in accordance with this specification, and as indicated on the cable schedules and drawings.
- B. Install each cable as an uninterrupted conductor section between the designated termination points, unless otherwise directed by the cable installation specifications. There shall be no splices or mechanical coupler installed between the cable points of origin and termination except as shown on drawings and or specifications.
- C. Unless otherwise noted, all cable shall be routed through the building cable tray/conduit system where available. Coordinate with the Division 16 Contractor on cable tray sizing. Prior to installation, check the sizes of the cable tray specified in section 16115 and confirm that it has adequate capacity for the quantity of cables required. Notify the Architect prior to tray ordering and installation if there are any problem areas.
- D. Coordinate the location of cable tray installed under Section 16115 to assure that required EIA/TIA clearances are maintained from line voltage power conduit (12"), motors and transformers (40"), and fluorescent fixtures (12"). Observe proper clearances for all installed cable.

DATC COSMETOLOGY REMODEL

- E. Contractor is responsible for insuring that cable jacket is suitable for the environment in which it is placed ie: CM, CMR, CMP rated.
- F. All cable shall be attached to building structure except as noted below, at intervals not to exceed those mandated by the National Electrical Code.
- G. At the same time cable is pulled into a cable pathway, also install a pull string of appropriate size to facilitate future cable pulls along those pathways.
- H. Install "J-hooks" for horizontal cable support. Coordinate location of support hardware to avoid conflicts with other trades.
- I. At no point will any station cable be tie wrapped or fastened to the cable tray. After cables have exited the cable tray they will be tie wrapped to the "J-hooks". The tie wraps will be cinched snug enough around the cable bundle to keep them uniform and in the hooks, but not so tight as to damage the construction of the cables themselves.
- J. Installation of workstation cables shall be coordinated with the modular furniture system contractor. Prior to the furniture system installation, the workstation cables will be pulled near the "stub-ups" or "poke-thrus" and left coiled with enough slack to reach the eventual outlet location. After the modular furniture systems are installed and walls are finished, the contractor will pull cable to the outlet locations and complete the cable installation.
- K. Backbone and station cables shall be provided with an 8 foot service loop at all MDF and IDF locations.
- L. Provide firestopping at all locations where cables penetrate fire rated surfaces. Materials and methods used shall be acceptable to the code authority having jurisdiction and shall maintain the fire integrity of the wall, floor, or ceiling.

3.2 CABLE IDENTIFICATION:

- A. Cable tags containing a unique cable ID designator shall be placed on both ends of all cables, 6 inches from the connector and /or termination blocks. Also label all backbone cables passing through telecommunications rooms. Each label shall be pre-printed with the appropriate cable number as indicated. Hand written cable labels are not acceptable.
- B. Individual station outlets shall be labeled with the designator of the cables terminated at that particular outlet.
- C. If at any time during the job the cable tag becomes illegible or removed for whatever reason, the Contractor shall immediately replace it with a duplicate pre-printed cable tag at the Contractor's expense.
- D. Labeling sequence to be determined by the Owner and to be followed by the contractor.

3.3 TELECOMMUNICATION ROOMS:

- A. Provide plywood backboards where indicated on the plans. Backboards to be 3/4" AC fire rated plywood, 8' tall, width as indicated on the drawings.

DATC COSMETOLOGY REMODEL

3.4 TERMINATION HARDWARE

- A. Quantities of termination blocks, racks, splice enclosures, and patch panels, etc. shown on drawings are illustrative only and are meant to indicate the general configuration of the work. The Contractor is responsible for providing the correct quantities of termination hardware required to terminate, patch, cross connect, etc. the volume of cable described herein and shown on the drawings. Rack quantities shall be no less than what is shown on the drawings.
- B. At all times during the construction, the Contractor shall protect the equipment from damage and theft. Equipment shall not be installed until such time as other trades have completed their work in the area.

3.5 CABLE TERMINATION:

- A. Fiber optic cables: After dressing the fiber to its final destination, sheath shall be removed to a point that allows the fibers to be splayed and terminated in a neat and uniform fashion. At this point all fiber strands will be terminated in strict compliance with the manufacturer's instructions.
- B. Twisted pair metallic cables: After dressing cable to its final location the sheath shall be removed to a point that allows the conductors to be splayed and terminated in a neat and uniform fashion. Every effort must be made to maintain sheath integrity by removing only as much as is practical to accomplish termination. Cable pair twist shall be maintained up to the point of termination. Under no circumstances shall cable pairs be untwisted or otherwise altered prior to termination.

3.6 CROSS-CONNECT:

- A. Twisted pair metallic cable: Perform all necessary cross-connect and patches as indicated in these specifications. Utilize cross-connect wire, and 25 pair cable as necessary. Cut all cross-connect wire to length, leaving enough slack to form a "3-finger loop". After completion of work, dress patch cords and cross-connect wire in cable management apparatus. Do not tie-wrap cross-connect wires into bundles.
- B. Phone Switch: Cross-connect all pairs of the voice entrance cable and station cabling to the phone switch termination blocks.
- C. Telecommunication distribution rooms/closets: Cross-connect "voice" station cable to the "voice " backbone.
- D. Cross connect cables terminating on protection blocks shall be 25 pr 24 AWG solid copper conductors under a common outer sheath. The cable shall meet the requirements for Category 3 horizontal UTP cable of EIA/TIA/ TSB-36.
- E. The contractor is responsible for providing all cross-connect schedules and documentation for Contractor installed cross connects and patching, to the Owner/Consultant on completion of project.

DATC COSMETOLOGY REMODEL

3.7 GROUNDING:

- A. All metallic cable tray, ladder rack, raceways, cable sheath/armor, enclosures, and equipment racks and other conductive surfaces shall be properly bonded to the grounding system. All paint and other coatings shall be removed at all contact surfaces to ensure proper ground.
- B. Furnish and install an insulated # 6 copper ground wire from all telecommunication rooms to the main building electrical ground point in the main electrical room. Drawing notes indicating a larger size shall take precedence.
- C. All grounding shall be in compliance with the NEC code Article 800, Article 250, well as EIA/TIA standard 607.

3.8 CABLE TESTING:

- A. Copper
 - 1. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.
 - 2. Conduct cable testing as described below upon completion of installation. Test fully completed systems only. Piecemeal testing is not acceptable, except by prior written approval from the Architect.
 - 3. After terminating both ends, but before any cross connects are installed, test all UTP voice and data station cables for attenuation and for near-end cross talk (NEXT) to ■ 100 ■ 250 ■ Mhz. Test all UTP backbone cable for cable pair/conductor continuity, ground fault, proper cross-connect, shorts and crossed pairs.
- B. Fiber
 - 1. Visually inspect all fiber, fiber reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.
 - 2. Conduct fiber testing as described below upon completion of installation. Test fully completed systems only. Piecemeal testing is not acceptable, except by prior written approval from the Architect.
 - 3. After installation of connectors, visually inspect each fiber end-face at 10X magnification. Refinish fibers with visible defects and/or variations in the core area.
 - 4. Perform end-to end, bi-directional attenuation (loss) test for each fiber strand at 850nm and 1300nm wave lengths. Conduct tests in accordance with EIA/TIA-526-14, method B and with test instrument manufacturers printed instructions.

DATC COSMETOLOGY REMODEL

5. Demonstrate that measured link loss does not exceed the "worst case" allowable loss which is the sum of: the connectors loss (based on the number of mated connector pairs at the EIA/TIA-568 maximum allowable loss of 1.0 db per mated pair) and the optical fiber loss (based on the EIA/TIA-568 maximum allowable loss of 3.75 db/km @ 850nm and 1.5dB/km @ 1300nm).
6. Strands whose measured attenuation falls outside the acceptable range shall be subject to further inspection and testing to determine the nature of the fault. At a minimum, an OTDR shall be used to determine the true loss for each connector pair, the exact length of the fiber, and to identify the presence of any core damage.
7. Faults related to connectorization shall be corrected, and the fiber re-tested as stated in the paragraph above until acceptable attenuation measurements are recorded.
8. Where defects are found to be inherent in the fiber itself, fiber must be removed and replaced. Also replace any cable having fewer than the manufactures guaranteed number of serviceable fibers.
9. Remove all defective cables from pathways system. Do not abandon cables in place.
10. The Architect reserves the right to observe the conduct of any or all portions of the testing process.
11. The Architect further reserves the right to conduct, using Contractor equipment and labor, a random re-test of up to five percent (5%) of the cable plant to confirm documented test results.
12. All test results and corrective procedures are to be documented and submitted to the Owner within fourteen (14) working days of test completion.

3.9 ACCEPTANCE:

- A. Upon receipt of the Contractor's documentation of cable testing, the Architect will review the installation and may request a test in his presence, of up to 1% of the cables/wires installed.

END OF SECTION