MICHIGAN STATE
UNIVERSITY

ELECTRONIC BIDDING

MSU BASE CONTRACTORS ONLY
SPECIFICATION FOR

Life Science – Renovations to Room B108A

PROJECT NUMBER

CP23077

Friday, February 16, 2024

AT

MICHIGAN STATE UNIVERSITY
EAST LANSING, MICHIGAN

Infrastructure Planning and Facilities
Planning, Design and Construction

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SCHEDULE OF DRAWINGS

Project Title: **Life Science – Renovations to Rooms B108A**
Capital Project Number: **CP23077**
No. of Sheets: **36**

ADVERTISEMENT FOR BIDS

DATE: **March 1, 2024**

PROJECT TITLE: **Life Science – Renovations to Rooms B108A**

PROJECT NUMBER: **CP23077**

for

MICHIGAN STATE UNIVERSITY

located at

EAST LANSING, MICHIGAN

OWNER: BOARD OF TRUSTEES
MICHIGAN STATE UNIVERSITY

ENGINEER/ARCHITECT: Fishbeck
1515 Arboretum Dr SE
Grand Rapids, MI 49546

DESIGN REPRESENTATIVE: **Kristin Nyht 248-862-7469**

PROJECT MANAGER: **Zach Kiefer 248-425-0360**

Fishbeck
1515 Arboretum Drive S.E.
Grand Rapids, MI 49546

BID DUE DATE: Until **3:00 p.m.** on **Friday, March 22, 2024**, the Owner will receive bids for the work as set forth in the Bidding Documents at via the Owner's Oracle Primavera Unifier Bid Manager, at which time and place all proposals will be publicly opened. Bidders are responsible for properly registering for this process, and familiarizing themselves with the system and its requirements. Registration information can be found at https://ipf.msu.edu/construction/partners/prospective-partners.

Proposals are invited for the following work:
Proposal 1 – General Construction Work

This project involves the remodel of Rooms B123/A/B and B120/A/B/C/D into clinical teaching and office spaces and the remodel of Rooms B108A/D and B107/A in to two simulation labs. An add alternate is requested for the main corridor between these rooms, Corridor 1HW3. This corridor is designed to be remodeled and would include touch down spaces and wayfinding, if completed. Abatement/demo by Owner.

MSU Base Contractors: For materials and methods not specified within these documents, the Constructor is expected to refer to and comply with MSU technical standards and standard details.

The substantial construction completion date for the project, as set forth in the project manual and drawings is **August 16, 2024**. See applicable start date and interim completion dates in the General Requirements (Division One) – Part 1 Work Sequence section.

LIQUIDATED DAMAGES:
☐ Shall, or ☒ Shall not be assessed for Substantial Completion at:
$_____PER DAY

☐ Shall, or ☒ Shall not be assessed for Final Completion at:
$_____PER DAY

EXCLUSIONS FROM MUTUAL WAIVERS OF CONSEQUENTIAL DAMAGES:
DEFAULT IS NONE. (If exclusions apply, project team to insert applicable exclusions below).

_____

The complete set of documents is also available for viewing through our new MSU Plan Room or via the MSU Planning, Design and Construction (PDC) web page at https://ipf.msu.edu/construction/partners/prospective-partners and then select “dedicated plan room”.

PLAN ROOMS

The Bidding documents are on file and may be examined at the following locations during regular business hours, Monday through Friday:

Builders Exchange of Lansing &
Central Michigan
1240 East Saginaw
Lansing, MI 48906

Dodge Data & Analytics
25330 Telegraph Road, Suite 350
Southfield, MI 48009

Dodge Data & Analytics
914 E. Vine Street
Kalamazoo, MI 49001

Dodge Data & Analytics
1311 South Linden Road, Suite B
Flint, MI 48532

Builders Exchange
P.O. Box 2031
Grand Rapids, MI 49501

Tri-City Builders & Traders Exchange
334 South Water
Saginaw, MI 48607

Construction Association of Michigan
43636 Woodward Avenue
P. O. Box 3204
Bloomfield Hills, MI 48302-3204

Builders Exchange
3431 East Kilgore
Kalamazoo, MI 49001

CNS Construction News Service
of West Michigan, Inc.
1793 R. W. Berends Dr. SW.
Wyoming, MI 49509-4993

MMSDC Michigan Minority Supplier
Development Council.
100 River Place STE 300
Detroit, MI 48207

Builders Exchange of NW MI, Inc.
1373 Barlow St. , Suite 4
Traverse City, MI 49686

Capital Imaging
2521 East Michigan Avenue
Lansing, MI 48912

A pre-bid site inspection will be held on **Tuesday, March 12, 2024** at **9:30 a.m.**. All interested Contractors or Bidders are encouraged to attend. Interested parties should meet at the **main lobby of the Life Science Building, 1355 Bogue St., East Lansing, MI 48823**. All Contractors submitting bids for the work will be held to have visited the site prior to submitting bids.

Each proposal shall be accompanied by a bid security as set forth in the Instructions to Bidders.

The Owner reserves the right to reject any or all proposals either in whole or in part and to waive any irregularities.

Withdrawal of any proposal is prohibited for a period of 120 days after the actual date of the opening thereof.

Performance and Labor and Material Bonds are required as set forth in the Instructions to Bidders.

All prospective Bidders, their Subcontractors and suppliers must be awardable by and in compliance with the directives and guidelines of the Contract Compliance Division of the Michigan Civil Rights Commission.

SUBCONTRACTING AND SUPPLIER DIVERSITY

The University makes a continuous effort to broaden its business relationships with Minority Business Enterprise (MBE) contractors, Women Business Enterprise (WBE) contractors, and small business concerns (including veteran-owned small business, service-disabled veteran owned small business, HUB Zone small business, and small disadvantaged business concerns certified by the U.S. Small Business Administration). For the purposes of this provision, suppliers are considered subcontractors. If third parties are needed to fulfill contractual obligations to the University, you are strongly encouraged to consider all qualified sources, including WBE, MBE, and small business subcontractors. For purposes of this paragraph, MBE is defined as a business enterprise of which more than 50% of the voting shares or interest in the business is owned, controlled, and operated by individuals who are members of a minority and with respect to which more than 50% of the net profit or loss attributable to the business accrues to shareholders who are members of a minority. WBE is defined as a business enterprise of which more than 50% of the voting shares or interest in the business is owned, controlled, and operated by women and with respect to which more than 50% of the net profit or loss attributable to the business accrues to the women shareholders.

The apparent Low Bidder shall, within 24 hours, after receipt of bids, provide the names of any MBE/WBE/small business subcontractors, description of work to be done by each, dollar value of work, and percentage of contract price. This information shall be included with the contract breakdown specified in Section 012000.1.4 of the specifications.

The Michigan State University Purchasing Department maintains a list of known Minority and Women Business Enterprises in the region for informational purposes. Bidders can obtain a copy of this list by calling (517) 355-0357. This list is not intended to be comprehensive. Similarly, it does not constitute an endorsement or certification of acceptability of the contractors and vendors included.

INSTRUCTION TO BIDDERS

ARTICLE 1

DEFINITIONS

1.1 Bidding Documents include the Advertisement or Invitation to Bid, Instruction to Bidders, the Bid Form, other sample bidding and Contract forms and the proposed Contract Documents including any Addenda issued prior to receipt of Bids.

1.2 All definitions set forth in ConsensusDocs 200- Standard Agreement and General Conditions Between Owner and Constructor (as modified by MSU) and in other Contract Documents are applicable to the Bidding Documents.

1.3 **Addenda** are written or graphic instruments, issued by the Architect prior to the receipt of Bids, which modify or interpret the Bidding Documents by addition, deletions, clarifications or corrections.

1.4 A **Bid** is a complete and properly signed proposal to do the Work or designated portion thereof, for the sums stipulated therein, supported by data called for by the Bidding Documents.

1.5 **Base Bid** is the sum stated in the Bid for which the Bidder offers to perform the Work described as the base, to which Work may be added or deducted for sums stated in Alternate Bids.

1.6 An **Alternate Bid** (or Alternate) is an amount stated in the Proposal to be added to or deducted from the amount of the Base Bid if the corresponding change in project scope or materials or methods of construction described in the Bidding Documents is accepted.

1.7 A **Unit Price** is an amount stated in the Bid as a price per unit of measurement for materials or services as described in the Contract Documents.

1.8 A **Bidder** is one who submits a Bid for a prime Contract with the Owner for the Work described in the proposed Contract Documents.

1.9 A **Sub-bidder** is one who submits a Bid to a Bidder for materials or labor for a portion of the Work.

1.10 **Bid Manager** is the Oracle Primavera Unifier Bid Manager application used the by the Owner to received competitive bids for this project.

ARTICLE 2

BIDDER'S REPRESENTATION

2.1 Each Bidder, by making his/her Bid, represents that:

2.1.1 They have read and understand the Bidding Documents and their Bid is made in accordance therewith.

2.1.2 They have visited the site and are familiar with the local conditions under which the Work is to be performed.

2.1.3 Their Bid is based upon the materials, systems and equipment described in the Bidding Documents, without exceptions.

ARTICLE 3

BIDDING DOCUMENTS

3.1 COPIES

3.1.1 Bidders may obtain complete sets of the Bidding Documents via the MSU PLANNING, DESIGN AND CONSTRUCTION web page at https://ipf.msu.edu/construction/partners/prospective-partners, or as outlined in the Advertisement for Bids, page AB-2.

3.1.2 Complete sets of Bidding Documents shall be used in preparing Bids; neither the Owner nor the Architect assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

3.1.3 The Owner or Architect, in making copies of the Bidding Documents available on the above terms, does so only for the purpose of obtaining Bids on the Work and does not confer a license or grant for any other use.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

3.2.1 Bidders shall promptly notify the Architect of any ambiguity, inconsistency or error which they may discover upon examination of the Bidding Documents or of the site and local conditions.

3.2.2 Bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to be received by the Architect at least fourteen days prior to the date for receipt of Bids.

3.2.3 Any interpretation, correction or change of the Bidding Documents will be made by Addendum. Interpretations, corrections or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes.

3.3 SUBSTITUTIONS

3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

3.3.2 No substitution will be considered unless written request for approval has been submitted by the Bidder and has been received by the Architect at least fourteen days prior to the date for receipt of Bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data, and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or work that incorporation of the substitute would require shall be included. It is the burden of the bidder proposing the substitution to establish its merits. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

3.3.3 If the Architect approves any proposed substitution, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

3.4 ADDENDA

3.4.1 The Architect and Owner will endeavor to notify all known plan holders of addenda issued, but it is the Bidder’s responsibility to verify receipt of all addenda.

3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

3.4.3 Normally Addenda will not be issued later than five days prior to the date for receipt of Bids except an Addendum, if necessary, postponing the date for receipt of Bids or withdrawing the request for Bids.

3.4.4 Each Bidder shall ascertain prior to submitting their Bid that they have received all Addenda issued, and receipt of all Addenda shall be acknowledged on their bid.

ARTICLE 4

BIDDING PROCEDURE

4.1 FORM AND STYLE OF BIDS

4.1.1 Bids shall be submitted via the Bid Manager on the form specified.

4.1.2 All fields on the Bid Form shall be completed.

4.1.3 All requested Alternates shall be listed and quoted in the Bid Manager. Failure to quote a requested Alternate will be cause to reject the Bid.

4.1.3.1 If an alternate is added via Addendum, bidders will include by [adding new line to bid form, clearly labeling ALTERNATE X(x being the number)] or [providing pricing on an attachment, also clearly labeling pricing for Alternate.]

4.1.4 All requested Unit Prices shall be listed and quoted via attachment in the Bid Manager. Failure to quote a requested Unit Price will be cause to reject the Bid.

4.1.5 Acknowledge the receipt of the last Addendum on the Bid Form. By acknowledging this addendum, Bidder also acknowledges receipt of all prior consecutive addenda (e.g., acknowledging Addendum 3 also acknowledges Addendum 1 and 2).

4.1.6 Bidder shall make no additional stipulations on the Bid Form nor qualify its Bid in any manner.

4.1.7 By submitting a Bid via the Bid Manager, the Bidder has committed the offer to perform the Work. The Owner will rely on this document as properly signed by the Bidder. The Owner may rely on this commitment, including submitting a claim on the Bidder's Bid Bond if they fail to enter into a contract per the project manual.

4.2 BID SECURITY

4.2.1 Any base bid greater than $50,000 shall be accompanied by a Bid Security in the form of a bid bond made payable to the Board of Trustees, Michigan State University, in the amount of not less than five percent (5%) of the Base Bid, as a proposal guarantee, pledging that the Bidder will enter into a Contract with the Owner on the terms stated in its Bid, and will furnish bonds as described hereunder in Article 8 covering the faithful performance of the Contract and the payment of all obligations arising thereunder. Bidder shall attach a scanned copy of the bid bond to the bid in Unifier Bid Manager.

As an alternative to a bid bond, Bidders may provide certified check, cashiers' check, or money order made payable to the Board of Trustees, Michigan State University, in the amount of not less than five percent (5%) of the Base Bid, to be delivered to MSU Infrastructure Planning and Facilities, 1147 Chestnut Road, Room 101, East Lansing, MI 48824. The proposal guarantee of Bidders under consideration will be returned immediately after approval of contracts by the Owner; those of all others will normally be returned upon request within 48 hours after bid opening.

Should the Bidder refuse to enter into a Contract, or fail to furnish such bonds within 30 days of notification of intent to award, the amount of the Bid Security shall be forfeited to the Owner as liquidated damages, not as penalty.

4.2.2 The bonding firm must be listed on the current U.S. Department of Treasury Circular 570, rated A- or better by Best, and be licensed to do business in the State of Michigan. The bonds are to be made out to "Michigan State University, Board of Trustees."

4.2.3 The Owner will have the right to retain the Bid Security of Bidders under consideration until either (a) the Contract has been executed and bonds have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

4.3 SUBMISSION OF BIDS

4.3.1 Bids shall be completed prior to the time and date for receipt of Bids indicated in the Advertisement or Invitation to Bid, or any extension thereof made by Addendum. Bids received after the time and date for receipt of Bids will not be considered.

4.3.2 Bidder shall assume full responsibility for timely delivery at location designated for receipt of Bids.

4.3.3 Oral, telephone, paper, or faxed Bids are invalid and will not receive consideration.

4.4 MODIFICATION OR WITHDRAWAL OF BID

4.4.1 A Bid may not be modified, withdrawn, or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and Bidder so agrees in submitting his/her Bid.

4.4.2 Prior to the time and date designated for receipt of Bids, Bids submitted early may be modified or withdrawn only by withdrawing current Bid, and resubmitting within the Bid Manager.

4.4.3 Bid security shall be in an amount sufficient for the Bid as modified or resubmitted.

4.5 BIDDER REGISTRATION

4.5.1 The Owner will only receive Bids via the Bid Manager, which requires prior registration and invitation. The Bidder is responsible to familiarize itself with this system and request access in a timely manner.

4.5.2 The Owner will endeavor to maintain a list of all interested bidders, and invite to all public bids. Bidders interested in being added to this list must register. Registration information can be found at https://ipf.msu.edu/construction/partners/prospective-partners.

4.5.3 Bidders are encouraged to continue to monitor projects via plan rooms and other advertising venues. They must express interest to bid on MSU projects by request at least 7 days prior to a bid opening. Owner takes no responsibility for inviting a bidder after that date.

ARTICLE 5

CONSIDERATION OF BIDS

5.1 OPENING OF BIDS

5.1.1 Unless stated otherwise in the Advertisement or Invitation to Bid, the properly identified Bids received on time will be opened publicly and will be read aloud. Opening will generally take place in MSU Infrastructure Planning and Facilities Building, 1147 Chestnut Road, East Lansing, Michigan 48824.

5.1.1.1 Unless stated otherwise in the Advertisement or Invitation to Bid, the Owner will endeavor to share bid results within 24 hours of opening.

5.1.1.2 The Owner will endeavor to stream the bid opening, and will share details in the bid invitation

5.2 REJECTION OF BIDS

5.2.1 The Owner shall have the right to reject any or all Bids.

5.3 ACCEPTANCE OF BID (AWARD)

5.3.1 The Owner shall have the right to waive any informality or irregularity in any Bid received.

5.3.2 If the University accepts any alternates, it will do so in the order representing the Owner's opinion of the best value to Michigan State University. The Owner shall be the sole judge of value. The low bidder will be determined on the basis of the sum of the base bid and the alternates accepted.

5.4 ACCEPTANCE OF CONTRACTOR AND SUBCONTRACTORS

5.4.1 Each portion of the Work shall be performed by an organization equipped and experienced to do the Work in each particular field, and no portion shall be reserved by the Contractor unless they are so equipped and experienced. Within 24 hours after the receipt of Bids, the successful Contractor shall submit a list of each Subcontractor proposed for each section of the Work. Subcontractors shall be satisfactory to the Owner. Unless authorized to the contrary in writing from the Owner, Subcontracts shall be awarded to the firms named in this list. Acceptance of the Bid does not imply approval of the Subcontractors subsequently named, but each Subcontractor shall be approved individually.

ARTICLE 6

QUALIFICATION OF CONTRACTORS

6.1 SUBMISSION OF QUALIFICATION STATEMENT

6.1.1 Bidders to whom award of a Contract is under consideration shall submit to the Architect upon his/her request, a properly executed Contractor's Qualification Statement, Consensus Docs 221 – Constructor's Statement of Qualifications for a Specific Project, unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

6.2 NONDISCRIMINATION

6.2.1 In performing under this Contract, the Contractor agrees not to discriminate against any employee, or applicant for employment, with respect to hire, tenure, terms, conditions or privileges of employment, or any matter directly or indirectly related to employment, because of race, color, religion, national origin, age, sex, height or weight, marital status or handicap. Subcontracts with each Subcontractor will contain a provision requiring nondiscrimination in employment, as herein specified. Any breach of this covenant may be regarded as a material breach of this Contract. The foregoing is included as a part of the University's institutional Affirmative Action/Equal Opportunity commitment.

6.3 APPROVED ASBESTOS ABATEMENT CONTRACTORS

6.3.1 The Department of Environmental Health and Safety (EHS) annually prequalifies asbestos abatement contractors to perform asbestos abatement work on Campus. Asbestos abatement work shall only be performed by one of the asbestos abatement contractors on the approved list. The current list is available from the PDC Project Representative, the Environmental Coordinator for EHS, and at https://ehs.msu.edu/enviro/asbestos/index.html.

ARTICLE 7

POST-BID INFORMATION

7.1 SUBMISSIONS

7.1.1 Unless waived by the Architect, the apparent low Bidder shall, within 24 hours after receipt of bids, submit the following information to the Architect:

7.1.1.1 A designation of the Work to be performed by the Bidder with their own forces.

7.1.1.2 The proprietary names and the suppliers of principal items or systems of material and equipment proposed for the Work.

7.1.1.3 A list of names of the Subcontractors or other persons or organizations (including those who are to furnish materials or equipment fabricated to a special design) proposed for each division and/or major subdivision, for the Owner’s approval.

7.1.1.4 The names of the MBE/WBE and a description of work to be done by each, dollar value of Work and percentage of Contract price.

7.1.1.5 List of representatives authorized to perform Unifier functions on behalf of the contractor using the Unifier New Company Request, available at Unifier System Vendor Information Form.

7.1.1.6 Certificate of Insurance demonstrating compliance with project requirements.

7.1.2 At the option of the Owner, the Bidder may be required to establish to the satisfaction of the Architect and the Owner the capability, reliability, and responsibility of the proposed Contractor and Subcontractors to furnish and perform the Work.

7.1.3 Subcontractors and other persons and organizations proposed by the Bidder and accepted by the Owner and the Architect must be used on the Work for which they were proposed and accepted and shall not be changed except with the written approval of the Owner and the Architect.

ARTICLE 8

PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

8.1 OWNER'S RIGHT TO REQUIRE BONDS

8.1.1 Each Bidder under a proposal in which the base bid exceeds $50,000, shall include the premiums for furnishing a Performance Bond and also Labor Material Bond, each in the full amount of the proposal sum as specified in the Owner / Constructor Agreement.

8.1.2 The bonding firm must be listed on the current U.S. Department of Treasury Circular 570, rated A- or better by Best, and be licensed to do business in the State of Michigan. The bonds are to be made out to "Michigan State University, Board of Trustees."

8.1.3 In assuming assigned Subcontractor by the successful Bidder for general building work as specified, each assigned Subcontractor for each Subcontract shall reimburse the General Contractor his/her proportionate share of the premiums for bonds.

8.2 TIME OF DELIVERY AND FORM OF BONDS AND INSURANCE

8.2.1 The Bidder shall deliver two (2) copies of the required bonds and insurance to the Owner not later than the date of execution of the Contract.

8.2.2 The Bidder shall require the Attorney-In-Fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of his/her Power of Attorney.

ARTICLE 9

FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

9.1 FORM TO BE USED

9.1.1 The Agreement for the Work will be governed by the project manual, and by the terms and conditions of ConsensusDocs 200- Standard Agreement and General Conditions Between Owner and Constructor (as modified by MSU).

9.1.2 If the project is under $250,000, an MSU Purchase Order will be used and the terms and conditions of ConsensusDocs 200- Standard Agreement and General Conditions Between Owner and Constructor (as modified by MSU), will serve as the applicable General Conditions for administration of the Work.

9.1.3 If the project is over $250,000, the ConsensusDocs 200- Standard Agreement and General Conditions Between Owner and Constructor will be used and the terms and conditions of that Agreement will be formalized through the execution of a Contract Finalization Form.

ARTICLE 10

APPLICATION FOR PAYMENT

10.1 FORM TO BE USED

10.1.1 Applications for Payment shall be submitted in Unifier in accordance with the Pay Apps (Pay Applications) business process. Refer to the MSU IPF website for more information

ARTICLE 11

ELECTRONIC TRANSACTIONS

11.1 UNIFIER

11.1.1 The Owner reserves the right to require that any or all transactions and submissions be conducted and delivered electronically through Unifier, a web-based project management software system. Unifier functions on most popular web browsers. If the owner requires the use of Unifier, the owner will provide the necessary licenses for access into Unifier and the initial training necessary to use Unifier. Access to Unifier will be password restricted, and any proposal, acceptance, quote or other information submitted through Unifier through the use of a party's password shall be deemed to be the submission of such party and any proposal, acceptance, quote or other information in the submission shall be binding on such party as if such proposal, acceptance, quote or other information was in a writing signed by such party. Owner shall not be required to verify the validity of any such submission or inquire as to the authority of the user gaining access to Unifier through the use of a party's password. The following are the minimum Unifier user software and hardware requirements. It is the responsibility of the vendor to verify compatibility of their systems with Unifier. For more information, see Unifier System Vendor Information Form.

11.2 CONTRACT EXECUTION

11.2.1 The Owner may choose to accept a scanned signed contract, provided through Unifier, as acceptance of the agreement. The Owner will rely on this document as properly signed by the Constructor.

State of Michigan

WHPWRequest@michigan.gov

General Request No.: 544
Requestor:
Project Description:
Project Number:

Statewide County
Commercial Prevailing Wage Rates

GENERAL INFORMATION

Classification Name	Description	Straight Hourly	Time and a Half	Double Time	Overtime Provision
A Operator (0-6 months)	IBEW 876 & IBEW 17 - Teledata	$38.27	$52.09	$65.91	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	
A Operator (7-12 months)	IBEW 876 & IBEW 17 - Teledata	$40.95	$55.96	$70.96	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
A Operator (over 1 yr)	IBEW 876 & IBEW 17 - Teledata	$45.81	$62.97	$80.12	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	
B Operator (0-6 months)	IBEW 876 & IBEW 17 - Teledata	$34.25	$46.29	$58.33	H H H X x X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	
B Operator (over 6 months)	IBEW 876 & IBEW 17 - Teledata	$39.35	$53.65	$67.94	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	

GENERAL INFORMATION

Classification Name / Description			Straight Hourly	Time and a Half	Double Time	Overtime Provision
Boilermaker						
Boilermaker		BO169	$72.47	$107.55	$142.63	H H H H H H H D Y
	Apprentice Rates:					
	1st Period		$53.53	$79.15	$104.75	
	2nd Period		$55.14	$81.56	$107.97	
	3rd Period		$56.73	$83.94	$111.15	
	4th Period		$58.31	$86.31	$114.31	
	5th Period		$59.85	$88.62	$117.39	
	6th Period		$63.03	$93.39	$123.75	
	7th Period		$66.17	$98.10	$130.03	
	8th Period		$69.32	$102.83	$136.33	
Bricklayer						
Brick Masonry, Stone Masonry, Artificial Masonry		BR2-31-BS	$53.52	$67.86	$82.19	H H H H H H H D N
	Apprentice Rates:					
	0-749 hours		$42.05	$50.65	$59.25	
	750-1,499 hours		$43.49	$52.81	$62.13	
	1,500-2,249 hours		$44.92	$54.95	$64.99	
	2,250-2,999 hours		$46.35	$57.10	$67.85	
	3,000-3,749 hours		$47.79	$59.26	$70.73	
	3,750-4,499		$49.22	$61.41	$73.59	
	4,500-5,249 hours		$50.65	$63.55	$76.45	
	5,250 hours		$52.09	$65.71	$79.33	
Pointing, Caulking and Cleaning		BR2-31-PCC	$53.52	$67.86	$82.19	H H H H H H H D N
	Apprentice Rates:					
	0-749 hours		$43.49	$52.81	$62.13	
	750-1,499 hours		$44.92	$54.95	$64.99	
	1,500- 2,249 hours		$46.35	$57.10	$67.85	
	2.250 -2,999 hours		$47.79	$59.26	$70.73	
	3,000-3,749 hours		$24.37	$36.56	$48.74	
	3,750-4,499 hours		$50.65	$63.55	$76.45	
	4,500 hours		$53.52	$67.85	$82.19	

General Request #: 544
Requestor:
Project Description:
Project Number:
County: Ingham

GENERAL INFORMATION

Date Rendered: 2/22/2024

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Cable spicer or COE foreman					
	IBEW 876 & IBEW 17 - Teledata	$42.53	$58.24	$73.94	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	
Cable spicer, Central Office Employee					
	IBEW 876 & IBEW 17 - Teledata	$40.71	$55.61	$70.51	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	
Carpenter					
Resilient floorlayer	CA1004FL	$49.49	$64.19	$78.89	X X H H H H H D N
	Apprentice Rates:				
	1st Year	$38.95	$48.46	$57.97	
	2nd Year	$40.31	$50.50	$60.69	
	3rd Year	$43.02	$54.57	$66.11	
	4th Year	$45.74	$58.65	$71.55	
Carpenter	CA1004L	$50.82	$65.79	$80.75	X X H H H H H D N
	Apprentice Rates:				
	1st Year	$41.84	$52.32	$62.79	
	2nd Year	$43.34	$54.57	$65.79	
	3rd Year	$46.33	$59.05	$71.77	
	4th Year	$49.32	$63.54	$77.75	

GENERAL INFORMATION

Classification Name	Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Cell Tower Tech						
		IBEW 876 & IBEW 17 - Teledata	$38.78	$52.83	$66.87	H H H X X X X D Y
	Apprentice Rates:					
	Lineman (6th - 6 months)		$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)		$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)		$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)		$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)		$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)		$22.91	$30.85	$38.78	
Cement Mason						
Cement Mason		BR2-31-CM	$47.16	$60.76	$74.36	X H H H H H H D N
	Apprentice Rates:					
	0-749 hours		$37.64	$46.48	$55.32	
	750-1,499 hours		$39.00	$48.52	$58.04	
	1,500-2,249 hours		$40.36	$50.56	$60.76	
	2,250-2,999 hours		$41.72	$52.60	$63.48	
	3,000-3,749 hours		$43.08	$54.64	$66.20	
	3,750-4,499 hours		$44.44	$56.68	$68.92	
	4,500 hours		$47.16	$60.76	$74.36	
Cement Mason		CE514-L	$47.09	$61.77	$76.45	H H H H H H H D Y
	Apprentice Rates:					
	1st Year		$36.81	$46.35	$55.89	
	2nd Year		$39.75	$50.76	$61.77	
	3rd Year		$42.69	$55.17	$67.65	
Communication Technician						
		IBEW 876 & IBEW 17 - Roadway	$67.89	$98.24	$128.58	H H H H H H H D Y

GENERAL INFORMATION

Classification Name / Description			Straight Hourly	Time and a Half	Double Time	Overtime Provision
Drywall						
Drywall Taper and Finisher		PT-845-DF	$44.64	$58.17	$71.75	H H H H H H H D N
	Apprentice Rates:					
	1st level		$31.06	$37.80	$44.59	
	2nd level		$36.49	$45.95	$55.45	
	3rd level		$41.92	$54.09	$66.31	
Electrician						
Inside wireman		EC-252-IW	$77.98	$100.47	$122.96	H H D H D D D D N
	Apprentice Rates:					
	1st Period		$44.21	$51.51	$59.94	
	2nd Period		$50.44	$62.70	$74.95	
	3rd Period		$55.95	$69.44	$82.94	
	4th Period		$61.46	$77.21	$92.95	
	5th Period		$66.96	$84.95	$102.94	
	6th Period		$72.47	$92.71	$112.95	
Subdivision of county	Townships of Onondaga, Leslie, Stockbridge and Bunker Hill ONLY.					
Sound and Communications Installer Technician BICSI certified & 6,000 OJT Straight time Rate $54.32 Time and Half $73.16 Double Time $91.99		EC-252-SC	$51.10	$66.96	$83.79	H H D H D D D D N
	Apprentice Rates:					
	Period 1		$33.56	$40.49	$48.72	
	Period 2		$35.31	$43.02	$52.07	
	Period 3		$37.07	$45.56	$55.43	
	Period 4		$38.82	$48.11	$58.80	
	Period 5		$40.57	$50.63	$62.14	
	Period 6		$44.09	$55.70	$68.85	
	Period 7		$47.59	$60.76	$75.56	
	Period 8		$49.34	$63.29	$78.92	
	Technician BICSI certification & 6,000 OJT		$54.32	$73.16	$91.99	
Subdivision of county	Onondaga, Leslie, Stockbridge & Bunker Hill townships					

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Inside Wireman	EC-665-IW	$69.20	$89.45	$109.70	H H D H H H D D Y
Apprentice Rates:					
1st Period		$27.98	$36.52	$45.06	
2nd period		$30.12	$39.72	$49.34	
3rd Period		$34.37	$45.05	$55.73	
4th Period		$49.01	$62.90	$76.79	
5th Period		$51.14	$66.10	$81.05	
6th Period		$53.28	$69.31	$85.33	
Subdivision of county	Lansing, Meridian, Williamston, Locke, Delhi, Alaiedon, Wheatfield, Leroy, Aurelius, Vevay, Ingham, & White Oak townships				
Sound and Communication Journeyman a 4 day schedule of ten hours a day is allowed Monday thru Friday.	EC-665-SD	$66.56	$86.06	$105.56	H H D H H H D D Y
Apprentice Rates:					
1st period		$26.80	$35.03	$43.26	
2nd period		$28.86	$38.11	$47.37	
3rd period		$32.98	$43.26	$53.55	
4th period		$47.07	$60.45	$73.82	
5th period		$49.13	$63.53	$77.94	
6th period		$51.19	$66.63	$82.05	
Subdivision of county	Lansing, Meridian, Williamston, Locke, Delhi, Alaiedon, Wheatfield, Leroy, Aurelius, Vevay, Ingham and White Oak townships				
Elevator Constructor					
Elevator Constructor Mechanic	EL-85	$96.72		$152.57	D D D D D D D D Y
Apprentice Rates:					
1st year		$68.96		$99.68	
2nd year		$74.88		$111.18	
3rd year		$77.85		$116.95	
4th year		$84.65		$129.33	

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Equipment Operator (line truck & man lifts)	IBEW 876 & IBEW 17 - Teledata	$38.78	$52.83	$66.87	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	
Fiber Optic Splicer	IBEW 876 & IBEW 17 - Roadway	$67.89	$98.24	$128.58	H H H H H H H D Y
Foreman	IBEW 876 & IBEW 17 - Roadway	$75.47	$109.61	$143.74	H H H H H H H D Y
In charge of three man crew	IBEW 876 & IBEW 17 - Teledata	$40.71	$55.61	$70.51	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	

GENERAL INFORMATION

Classification Name	Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Glazier						
Glazier	4 tens allowed on consecutive days	GL-826	$49.84	$67.73	$85.62	H H H H H H H D Y
	Apprentice Rates:					
	1st level		$31.62	$40.40	$49.18	
	2nd level		$35.12	$45.66	$56.18	
	3rd Level		$40.38	$53.54	$66.70	
	4th level		$45.66	$61.46	$77.26	
Heat and Frost Insulator						
Spray Insulation		AS25S	$25.29	$36.51	$47.73	X X X H H H H H N
Heat and Frost Insulator and Asbestos Worker						
Heat and Frost Insulators and Asbestos Workers		AS47	$52.00	$68.89	$85.77	X X X H H H H D Y
	Apprentice Rates:					
	1st year		$26.38	$33.69	$40.99	
	2nd year		$30.15	$38.92	$47.68	
	3rd year		$33.92	$44.15	$54.37	
	4th year		$37.70	$49.39	$61.08	
	5th year		$41.48	$54.63	$67.78	
IBEW 252						
Installor Technician		EC-252-sc				H H H D N
	Apprentice Rates:					
	Period 1		$33.56	$40.49	$48.72	
	Period 2		$35.31	$43.02	$52.07	
	Period 3		$37.07	$45.56	$55.43	
	Period 4		$38.82	$48.11	$58.80	
	Period 5		$40.57	$50.63	$62.14	
	Period 6		$44.09	$55.70	$68.85	
	Period 7		$47.59	$60.76	$75.56	
	Period 8		$49.34	$63.29	$78.92	
	Technician BICSI certification & 6,000 OJT		$54.32	$73.16	$91.99	

Subdivision of county Onondaga, Leslie, Stockbridge & Bunker Hill townships

General Request #: 544
Requestor:
Project Description:
Project Number:
County: Ingham

GENERAL INFORMATION

Date Rendered: 2/22/2024

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Installer - Repairman					
	IBEW 876 & IBEW 17 - Teledata	$38.78	$52.83	$66.87	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	
Ironworker					
Reinforced Iron Work	IR-25-RF	$69.51	$85.85	$102.19	H H D H H D D D N
	Apprentice Rates:				
	Level 8	$66.76	$82.48	$98.19	
	Level 7	$66.76	$82.48	$98.19	
	Level 1	$52.63	$64.23	$75.83	
	Level 2	$54.68	$66.77	$78.86	
	Level 3	$56.56	$68.98	$81.40	
	Level 4	$59.41	$72.65	$85.88	
	Level 5	$62.27	$76.32	$90.37	
	Level 6	$66.76	$82.48	$98.19	
Rigging Work	IR-25-RIG	$76.08	$92.93	$109.78	H H D H H H D D N
	Apprentice Rates:				
	Level 8	$69.43	$84.94	$100.45	
	Level 1	$51.75	$62.38	$73.01	
	Level 2	$52.56	$63.54	$74.52	
	Level 3	$54.83	$66.33	$77.83	
	Level 4	$57.51	$69.71	$81.91	
	Level 5	$60.60	$73.67	$86.74	
	Level 6	$63.27	$77.04	$90.80	
	Level 7	$66.35	$80.99	$95.62	

GENERAL INFORMATION

Classification Name	Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Structural, ornamental, welder and pre-cast	If bad weather, Friday may be a make up day. If holiday celebrated on a Monday, 4 10s may be worked Tuesday thru Friday.	IR-25-STR	$76.21	$102.75	$129.29	H H D H H H D D Y
	Apprentice Rates:					
	Level 8		$69.43	$84.94	$100.45	
	Level 1		$51.25	$61.88	$72.51	
	Level 2		$52.56	$63.54	$74.52	
	Level 3		$54.83	$66.33	$77.83	
	Level 4		$57.51	$70.34	$83.17	
	Level 5		$60.60	$73.67	$86.74	
	Level 6		$63.27	$77.04	$90.80	
	Level 7		$66.35	$80.98	$95.62	
Journeyman Signal Technician		IBEW 876 & IBEW 17 - Roadway	$67.89	$98.24	$128.58	H H H H H H H D Y
Journeyman Specialist		IBEW 876 & IBEW 17 - Roadway	$76.98	$111.87	$146.76	H H H H H H H D Y
Labor Crew Foreman		IBEW 876 & IBEW 17 - Roadway	$61.86	$89.19	$116.52	H H H H H H H D Y
Laborer						
Journeyperson - building and heavy construction craft laborer, portable concrete mixer operator, air, electric or gasoline tool operator, hot dope carrier, tar kettle tender, gasoline vibrators, concrete gas buggies, concrete saw, signal person and top pe		L499L	$38.53	$51.20	$63.86	X X H H H H H D Y
	Apprentice Rates:					
	0-1,000 hours		$32.20	$41.70	$51.20	
	1,001-2,000 hours		$33.46	$43.60	$53.73	
	2,001-3,000 hours		$34.73	$45.50	$56.26	
	3,001-4,000 hours		$37.26	$49.30	$61.33	
Ground Burner		L499LG	$50.83	$66.15	$81.46	X X H H H H H D Y

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
High Burner	L499LH	$51.33	$66.90	$82.46	H H H H H H H D Y
Apprentice Rates:					
Laborer Road Class 1: asphalt shoveler or loader, yard man, fence erector tender, dumper, joint filling, form setting, form stripper, pavement reinforcing, waterproofing, seal coating, bridge painting, sandblasting, pressure grouting, RC equipment	MITA-RZ2-C1	$45.39	$58.38	$71.36	H H H H H H H D Y
Apprentice Rates:					
3,001-4,000 hours					
2,001-3,000 hours					
1,001-2,000 hours					
0-1,000 hours					
3,001-4,000 hours		$44.09	$56.42	$68.76	
2,001-3,000 hours		$41.49	$52.52	$63.56	
1,001-2,000 hours		$40.20	$50.59	$60.98	
0-1,000 hours		$38.90	$48.64	$58.38	
Laborer Road Class 2: mixer operator, air or electric tool operator, spreader, boxman, concreter paddler, power chain saw operator, paving patch truck dumper, tunnel mucker, concrete saw operator, dry pack macine and roto-mill grounds person	MITA-RZ2-C2	$45.59	$58.18	$71.26	H H H H H H H D Y
Apprentice Rates:					
3,001-4,000 hours		$44.28	$56.21	$68.64	
2,001-3,000 hours		$41.66	$52.28	$63.40	
1,001-2,000 hours		$40.36	$50.33	$60.80	
0-1,000 hours		$39.05	$48.36	$58.18	
Laborer Road Class 3: tunnel miner, finish tenders, guard rail builder, median barrier installer, earth retention barrier and wall installer, fence erector, bottom man, powder man, wagon drill and air track operator, curb and side rail setter	MITA-RZ2-C3	$45.43	$58.64	$71.84	H H H H H H H D Y
Apprentice Rates:					
3,001-4,000 hours		$44.11	$56.66	$69.20	
2,001-3,000 hours		$41.47	$52.70	$63.92	
1,001-2,000 hours		$40.15	$50.72	$61.28	
0-1,000 hours		$38.83	$48.74	$58.64	

GENERAL INFORMATION

Classification Name / Description			Straight Hourly	Time and a Half	Double Time	Overtime Provision
Laborer Road Class 4: asphalt raker		MITA-RZ2-C4	$46.18	$59.56	$72.94	H H H H H H H D Y
	Apprentice Rates:					
	3,001-4,000 hours		$44.84	$57.55	$70.26	
	2,001-3,000 hours		$42.17	$53.54	$64.92	
	1,001-2,000 hours		$40.83	$51.54	$62.24	
	0-1,000 hours		$39.49	$49.52	$59.56	
Laborer Road Class 5: pipe layers, oxy-gun		MITA-RZ2-C5	$46.05	$59.37	$72.68	H H H H H H H D Y
	Apprentice Rates:					
	3,001-4,000 hours		$44.72	$57.37	$70.02	
	2,001-3,000 hours		$42.06	$53.38	$64.70	
	1,001-2,000 hours		$40.72	$51.37	$62.02	
	0-1,000 hours		$39.39	$49.38	$59.36	
Laborer Road Class 6: line form setter for curb or pavement, asphalt screed checker/screw man on asphalt paving machines		MITA-RZ2-C6	$46.39	$59.88	$73.36	H H H H H H H D Y
	Apprentice Rates:					
	3,001-4,000 hours		$45.04	$57.85	$70.66	
	2,001-3,000 hours		$42.34	$53.80	$65.26	
	1,001-2,000 hours		$41.00	$51.79	$62.58	
	0-1,000 hours		$39.65	$49.76	$59.88	
Laborer Road Class 7: concrete specialist - including finishing and trowling, cast in place or precast by any method		MITA-RZ2-C7	$48.96	$63.73	$78.50	H H H H H H H D Y
	Apprentice Rates:					
	3,001-4,000 hours		$47.48	$61.51	$75.54	
	2,001-3,000 hours		$44.53	$57.08	$69.64	
	1,001-2,000 hours		$43.05	$54.86	$66.68	
	0-1,000 hours		$41.58	$52.66	$63.74	
Asbestos & Lead Abatement Laborer 4 ten hour days @ straight time allowed Monday-Saturday, must be consecutive calendar days		MLDC	$50.60	$65.37	$80.13	H H H X X X X D Y
	Apprentice Rates:					
	Trainee 600 hours +1 year		$34.07			

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Laborer - Hazardous					
Class A Laborer - performing work in conjunction with site preparation and other preliminary work prior to actual removal, handling, or containment of hazardous waste substances not requiring use of personal protective equipment required by state or feder	LHAZ-Z6-A	$38.53	$51.20	$63.86	H H H H H H H D Y
Apprentice Rates:					
0-1,000 work hours		$32.20	$41.70	$51.20	
1,001-2,000 work hours		$33.46	$47.09	$60.72	
2,001-3,000 work hours		$34.73	$45.50	$56.26	
3,001-4,000 work hours		$37.26	$49.29	$61.32	
Class B Laborer - performing work in conjunction with the removal, handling, or containment of hazardous waste substances when the use of personal protective equipment levels "A", "B" or "C" is required.	LHAZ-Z6-B	$39.53	$52.70	$65.86	H H H H H H H D Y
Apprentice Rates:					
0-1,000 work hours		$32.95	$42.82	$52.70	
1,001-2,000 work hours		$34.26	$44.79	$55.32	
2,001-3,000 work hours		$35.58	$46.77	$57.96	
3,001-4,000 work hours		$38.21	$50.72	$63.22	
Laborer - Landscape					
Class B1: Landscape Operator includes air, gas, and diesel equipment operator, lawn sprinkler installer,skidsteer, mini excavators, backhoe loaders, ride and walk behind trenchers, off road dump vehicle, articulated haulers, hydroseeder, wheel loaders	LLAN-Z1-A	$32.40	$42.43	$52.95	X X H X X X H D Y
Class B2: Skilled Landscape Laborer: small power tool operator, lawn sprinkler installers' tender, irrigation installers' tender, material mover	LLAN-Z1-B	$30.40	$39.93	$49.45	X X H X X X H D Y
Class B1: Landscape Operatior includes air, gas, and diesel equipment operator, lawn sprinkler installer,skidsteer, mini excavators, ride and walk behind trenchers, backhoe loaders, off road dump vehicle, articulated haulers, hydroseeder, wheel loaders	LLAN-Z2-A	$32.40	$42.96	$53.48	X X H X X X H D Y
Class B2: Skilled Landscape Laborer: small power tool operator, lawn sprinkler installers' tender, irrigation installers' tender material mover	LLAN-Z2-B	$30.40	$39.93	$49.45	X X H X X X H D Y
Class C: landscape laborer with 90 or more calendar days worked	LLAN-Z2-C	$24.66	$33.27	$41.87	H H H H H H H D N
Class D: Inexperienced landscape laborer - individual who has worked less than 90 calendar days	LLAN-Z2-D	$15.54	$23.31	$31.08	H H H H H H H D N

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Laborer Underground - Tunnel, Shaft & Caisson					
Class I - Tunnel, shaft and caisson laborer, dump man, shanty man, hog house tender, testing man (on gas), and watchman.	LAUCT-Z2-1	$38.97	$50.26	$61.54	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$32.85	$42.64	$52.43	
1,001-2,000 work hours		$33.97	$44.32	$54.67	
2,001-3,000 work hours		$35.08	$45.99	$56.89	
3,001-4,000 work hours		$37.31	$49.33	$61.35	
Class II - Manhole, headwall, catch basin builder, bricklayer tender, mortar man, material mixer, fence erector, and guard rail builder	LAUCT-Z2-2	$39.06	$50.39	$61.72	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$32.92	$42.75	$52.57	
1,001-2,000 work hours		$34.04	$44.43	$54.81	
2,001-3,000 work hours		$35.16	$46.11	$57.05	
3,001-4,000 work hours		$37.39	$49.45	$61.51	
Class III - Air tool operator (jack hammer man, bush hammer man and grinding man), first bottom man, second bottom man, cage tender, car pusher, carrier man, concrete man, concrete form man, concrete repair man, cement invert laborer, cement finisher, con	LAUCT-Z2-3	$39.16	$50.54	$61.92	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$32.99	$42.85	$52.71	
1,001-2,000 work hours		$34.12	$44.55	$54.97	
2,001-3,000 work hours		$35.24	$46.23	$57.21	
3,001-4,000 work hours		$37.49	$49.60	$61.71	
Class IV - Tunnel, shaft and caisson mucker, bracer man, liner plate man, long haul dinky driver and well point man.	LAUCT-Z2-4	$39.58	$51.17	$62.76	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$33.11	$43.03	$52.95	
1,001-2,000 work hours		$34.25	$44.74	$55.23	
2,001-3,000 work hours		$35.38	$46.43	$57.49	
3,001-4,000 work hours		$37.64	$49.83	$62.01	

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Class V - Tunnel, shaft and caisson miner, drill runner, keyboard operator, power knife operator, reinforced steel or mesh man (e.g. wire mesh, steel mats, dowel bars)	LAUCT-Z2-5	$39.58	$51.17	$62.76	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$33.31	$43.33	$53.35	
1,001-2,000 work hours		$34.45	$45.04	$55.63	
2,001-3,000 work hours		$35.60	$46.77	$57.93	
3,001-4,000 work hours		$37.89	$50.20	$62.51	
Class VI - Dynamite man and powder man.	LAUCT-Z2-6	$39.34	$52.38	$65.41	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$33.54	$43.67	$53.81	
1,001-2,000 work hours		$34.70	$45.41	$56.13	
2,001-3,000 work hours		$35.86	$47.15	$58.45	
3,001-4,000 work hours		$38.18	$50.63	$63.09	
Class VII - Restoration laborer, seeding, sodding, planting, cutting, mulching and topsoil grading and the restoration of property such as replacing mail boxes, wood chips, planter boxes and flagstones.	LAUCT-Z2-7	$32.16	$40.04	$47.92	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$27.75	$34.99	$42.23	
1,001-2,000 work hours		$28.52	$36.15	$43.77	
2,001-3,000 work hours		$29.29	$37.30	$45.31	
3,001-4,000 work hours		$30.84	$39.63	$48.41	
Laborer -Underground Open Cut, Class I					
Construction Laborer	LAUC-Z3-1	$36.91	$47.01	$57.10	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$31.39	$40.40	$49.41	
1,001-2,000 work hours		$32.38	$41.88	$51.39	
2,001-3,000 work hours		$33.38	$43.38	$53.39	
3,001-4,000 work hours		$35.37	$46.37	$57.37	

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Laborer -Underground Open Cut, Class II					
Mortar and material mixer, concrete form man, signal man, well point man, manhole, headwall and catch basin builder, guard rail builders, headwall, seawall, breakwall, dock builder and fence erector.	LAUC-Z3-2	$37.05	$47.22	$57.38	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$31.49	$40.55	$49.61	
1,001-2,000 work hours		$32.49	$42.05	$51.61	
2,001-3,000 work hours		$33.50	$43.56	$53.63	
3,001-4,000 work hours		$35.50	$46.56	$57.63	
Laborer -Underground Open Cut, Class III					
Air, gasoline and electric tool operator, vibrator operator, drillers, pump man, tar kettle operator, bracers, rodder, reinforced steel or mesh man (e.g. wire mesh, steel mats, dowel bars, etc.), cement finisher, welder, pipe jacking and boring man, wagon	LAUC-Z3-3	$37.17	$47.40	$57.62	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$31.58	$40.68	$49.79	
1,001-2,000 work hous		$32.59	$42.20	$51.81	
2,001-3,000 work hours		$33.60	$43.72	$53.83	
3,001-4,000 work hours		$35.61	$46.73	$57.85	
Laborer -Underground Open Cut, Class IV					
Trench or excavating grade man.	LAUC-Z3-4	$37.22	$47.47	$57.72	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$31.62	$40.74	$49.87	
1,001-2,000 work hours		$32.63	$42.26	$51.89	
2,001-3,000 work hours		$33.64	$43.78	$53.91	
3,001-4,000 work hours		$35.66	$46.80	$57.95	
Laborer -Underground Open Cut, Class V					
Pipe Layer (including crock, metal pipe, multiplate or other conduits)	LAUC-Z3-5	$37.36	$47.68	$58.00	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$31.73	$40.91	$50.09	
1,001-2,000 work hours		$32.74	$42.42	$52.11	
2,001-3,000 work hours		$33.76	$43.96	$54.15	
3,001-4,000 work hours		$35.79	$47.00	$58.21	

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Laborer -Underground Open Cut, Class VI					
Grouting man, top man assistant, audio visual television operations and all other operations in connection with closed circuit television inspection, pipe cleaning and pipe relining work and the installation & repair of water service pipe & appurtenances	LAUC-Z3-6	$34.66	$43.63	$52.60	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$29.70	$37.86	$46.03	
1,001-2,000 work hours		$30.58	$39.18	$47.79	
2,001-3,000 work hours		$31.46	$40.50	$49.55	
3,001-4,000 work hours		$33.23	$43.16	$53.09	
Laborer -Underground Open Cut, Class VII					
Restoration laborer, seeding, sodding, planting, cutting, mulching and topsoil grading and the restoration of property such as replacing mail boxes, wood chips, planter boxes, flagstones etc.	LAUC-Z3-7	$31.81	$39.36	$46.90	X X X X X X X D Y
Apprentice Rates:					
0-1,000 work hours		$27.56	$34.66	$41.75	
1,001-2,000 work hours		$28.30	$35.76	$43.23	
2,001-3,000 work hours		$29.04	$36.88	$44.71	
3,001-4,000 work hours		$30.52	$39.10	$47.67	
Landscape Laborer					
Class A: Irrigation Foremen and Construction Foremen.	LLAN-Z1-A	$34.62	$46.26	$57.89	x X H X X x H D Y H
Lanscape Laborer					
Class A: Irrigation Foremen and Construction Foremen.	LLAN-Z1	$34.62	$46.26	$57.89	X X H X X X X D Y
Subdivision of county Zones 1 & 2					
Lineman, Teledata Wireman					
	IBEW 876 & IBEW 17 - Teledata	$38.78	$52.83	$66.87	H H H X X X X D Y
Apprentice Rates:					
Lineman (6th - 6 months)		$35.61	$49.90	$64.18	
Lineman (5th - 6 months)		$33.06	$46.07	$59.08	
Lineman (4th - 6 months)		$30.53	$42.27	$54.02	
Lineman (3rd - 6 months)		$27.99	$38.47	$48.94	
Lineman (2nd - 6 months)		$25.45	$34.66	$43.86	
Lineman (1st - 6 months)		$22.91	$30.85	$38.78	

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Operating Engineer					
Forklift, lull, extend-a-boom forkliftWork in excess of 12 per day M-F shall be paid at double time.	EN-324-FL	$63.36	$79.81	$96.25	X X X X D D D D Y
Class I - diver/wet tender, engineer, blaster, leverman	EN-324-Statewide	$82.82	$107.82	$132.82	x x X X X X X D N H
Class III - Deck equip. operator, maintenance of crane or excavator, tug/launch operator, loader/dozer on barge/deck machinery, truck-able tug, lead surveyor, ROV operator, AB deckhand, welder	EN-324-Statewide-III	$76.82	$98.82	$120.82	X X X X X X X D N
Class IV - Deck equipment operator, machineryman/fireman, off road trucks, deck hand, tug engineer, assistant tug operator, blaster helper, deck hand, jet machine, subsea plow, trencher, tug engineer	EN-324-Statewide-IV	$72.32	$92.07	$111.82	H X X X X X X D N x
Ind. Forklift/forktruck under 5,000 lb capacity power jacks/poer packs, composite crew only	EN-324-SW	$64.70	$81.75	$98.80	H H D H H H D D Y
Compressor or Welding MachineFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday.	EN-AC	$56.05	$69.32	$82.58	X X X X D D D D Y
Forklift or Straight Mast Four 10 hour days may be scheduled M-Th or T-F. Work not performed due to weather on M-Th may be scheduled on Friday	EN-F	$57.50	$71.40	$85.29	X X X X D D D D Y
Fireman or Oiler Four 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday.	EN-FO	$55.02	$67.84	$80.65	X X X X D D D D Y
Lull or Extend-a-Boom ForkliftFour 10 hour days may be scheduled M-Th or T-F. Work not performed due to weather on M-Th may be scheduled on Friday	en-l	$59.73	$77.09	$94.45	X X H H D D D D Y
Crane with main boom & jib 120' or longerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Worked not performed due to weather, Monday-Thursday may be scheuled Friday	en-os120	$63.27	$82.40	$101.53	X X H H D D D D Y
Crane w/ main Boom & Jib 220' or longerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday.	EN-OSA	$64.38	$84.07	$103.75	X X H H D D D D Y

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Crane w/ main Boom & Jib 300' or longerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work unabled to be performed due to weather, Monday-Thursday may be scheduled on Friday.	EN-OSA3	$65.89	$86.33	$106.77	X X H H D D D D Y
Crane w/ main Boom & Jib 400' or longerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday.	EN-OSA4	$78.46	$101.49	$124.52	X X X X X X X D Y
Crane with main boom and jib 140' or longerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work unabled to be performed due to weather, Monday-Thursday may be scheduled on Friday.	EN-OSB	$64.09	$83.63	$103.17	X X H H D D D D Y
Regular Crane Operator, Job Mechanic, Concrete Pump with BoomFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday.	EN-RC	$66.04	$83.65	$101.26	X X X X D D D D Y
Apprentice Rates:					
0-999 hours		$51.13	$64.18	$77.22	
1,000-1,999 hours		$52.99	$66.96	$80.94	
2,000-2,999 hours		$54.86	$69.77	$84.68	
3,000-3,999 hours		$56.72	$72.56	$88.40	
4,000-4,999 hours		$58.59	$75.36	$92.14	
5,000-5,999 hours		$60.44	$78.15	$95.84	
Regular Engineer, Hydro Excavator & Remote Controlled Concrete BreakerFour 10 hour days may be scheduled Monday-Thursday or Tuesday-Friday. Work not performed due to weather, Monday-Thursday may be scheduled on Friday.	en-re	$65.07	$82.26	$99.44	X X X X D D D D Y
Apprentice Rates:					
5,000-5,999 hours		$63.09	$81.87	$100.64	
4,000-4,999 hours		$61.11	$78.90	$96.68	
3,000-3,999 hours		$59.13	$75.93	$92.72	
2,000-2,999 hours		$57.16	$72.97	$88.78	
1,000-1,999 hours		$55.19	$70.02	$84.84	
1-999 hours		$53.21	$67.02	$80.85	

Classification Name	Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Journeyman - Class IV		OE-324-Statewide	$56.46	$70.09	$83.72	X X X X X X X D Y
	Apprentice Rates:					
	31-36 months		$62.01	$80.44	$98.88	
	25-30 months		$60.08	$77.54	$95.01	
	19-24 months		$58.13	$74.62	$91.13	
	13-18 months		$56.19	$71.72	$87.24	
	7-12 months		$54.25	$68.81	$83.36	
	0-6 months		$48.21	$59.76	$71.29	
	Apprentice Rates:					
	31-36 months		$62.01	$80.44	$98.88	
	25-30 months		$60.08	$77.54	$95.01	
	19-24 months		$58.13	$74.62	$91.13	
	13-18 months		$56.19	$71.72	$87.24	
	7-12 months		$54.25	$68.81	$83.36	
	0-6 months		$48.21	$59.76	$71.29	
	Apprentice Rates:					
	31-36 months		$62.01	$80.44	$98.88	
	25-30 months		$60.08	$77.54	$95.01	
	19-24 months		$58.13	$74.62	$91.13	
	13-18 months		$56.19	$71.72	$87.24	
	7-12 months		$54.25	$68.81	$83.36	
	0-6 months		$48.21	$59.76	$71.29	
	Apprentice Rates:					
	31-36 months		$62.01	$80.44	$98.88	
	25-30 months		$60.08	$77.54	$95.01	
	19-24 months		$58.13	$74.62	$91.13	
	13-18 months		$56.19	$71.72	$87.24	
	7-12 months		$54.25	$68.81	$83.36	
	0-6 months		$48.21	$59.76	$71.29	

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Apprentice Rates:					
31-36 months		$62.01	$80.44	$98.88	
25-30 months		$60.08	$77.54	$95.01	
19-24 months		$58.13	$74.62	$91.13	
13-18 months		$56.19	$71.72	$87.24	
7-12 months		$54.25	$68.81	$83.36	
0-6 months		$48.21	$59.76	$71.29	
Operating Engineer - Marine Construction					
Diver/Wet Tender/Tender/Rov Pilot/Rov Tender	GLF D	$52.81	$78.57	$104.32	H H H H H H H D N
Diver/Wet Tender, Engineer (hydraulic dredge)	GLF-1	$78.97	$102.47	$125.97	X X H H H H H D Y
Subdivision of county all Great Lakes, islands therein, & connecting & tributary waters					
Crane/Backhoe Operator, 70 ton or over Tug Operator, Mechanic/Welder, Assistant Engineer (hydraulic dredge), Leverman (hydraulic dredge), Diver Tender	GLF-2	$77.47	$100.22	$122.97	X X H H H H H D Y
Subdivision of county All Great Lakes, islands therein, & connecting & tributary waters					
Friction, Lattice Boom or Crane License Certification30	GLF-2B	$78.97	$102.47	$125.97	X X H H H H H D Y
Subdivision of county All Great Lakes, islands, therein, & connecting & tributary waters					
Deck Equipment Operator, Machineryman, Maintenance of Crane (over 50 ton capacity) or Backhoe (115,000 lbs or more), Tug/Launch Operator, Loader, Dozer on Barge, Deck Machinery	GLF-3	$72.92	$93.40	$113.87	X X H H H H H D Y
Subdivision of county All Great Lakes, islands therein, & connecting & tributary waters					
Deck Equipment Operator, (Machineryman/Fireman), (4 equipment units or more), Off Road Trucks, Deck Hand, Tug Engineer, & Crane Maintenance 50 ton capacity and under or Backhoe 115,000 lbs or less, Assistant Tug Operator	GLF-4	$66.72	$84.10	$101.47	X X H H H H H D Y
Subdivision of county All Great Lakes, islands therein, & connecting & tributary waters					
Operating Engineer Steel Work					
Extended boom forklift over 5,000 lb capacity, 1 Drum Hoist	EN-324-ef	$69.61	$88.88	$108.15	H H D H H H D D Y
Crane w/ 120' boom or longer	EN-324-SW120	$74.14	$95.24	$116.33	H H D H H H D D Y
Crane w/ 120' boom or longer w/ Oiler	EN-324-SW120-O	$75.01	$96.54	$118.07	H H D H H H D D Y
Crane w/ 140' boom or longer	EN-324-SW140	$75.19	$96.80	$118.41	H H D H H H D D Y

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Crane w/ 140' boom or longer W/ Oiler	EN-324-SW140-O	$76.19	$98.24	$120.28	H H D H H H D D Y
Boom & Jib 220' or longer	EN-324-SW220	$76.46	$98.62	$120.78	H H D H H H D D Y
Crane w/ 220' boom or longer w/ Oiler	EN-324-SW220-O	$74.01	$95.11	$116.20	H H D H H H D D Y
Boom & Jib 300' or longer	EN-324-SW300	$76.96	$99.34	$121.72	H H D H H H D D Y
Crane w/ 300' boom or longer w/ Oiler	EN-324-SW300-O	$77.96	$100.78	$123.59	H H D H H H D D Y
Boom & Jib 400' or longer	EN-324-SW400	$78.46	$101.49	$124.52	H H D H H H D D Y
Crane w/ 400' boom or longer w/ Oiler	EN-324-SW400-O	$79.46	$102.93	$126.39	H H D H H H D D Y
Crane Operator, Job Mechanic, 3 Drum Hoist & Excavator	EN-324-SWCO	$73.65	$94.59	$115.53	H H D H H H D D Y
Apprentice Rates:					
0-999 hours		$59.16	$76.02	$92.88	
1,000-1,999 hours		$61.56	$79.63	$97.68	
2,000-2,999 hours		$63.96	$83.22	$102.48	
3,000-3,999 hours		$66.38	$84.18	$101.98	
4,000-4,999 hours		$68.78	$90.46	$112.12	
5,000 hours		$71.20	$91.09	$110.99	
Crane Operator w/ Oiler	EN-324-SWCO-O	$74.65	$96.03	$117.40	H H D H H H D D Y
Compressor or Welder Operator	EN-324-SWCW	$37.03	$49.48	$61.92	H H D H H H D D Y
Hoisting Operator, 2 Drum Hoist, & Rubber Tire Backhoe	EN-324-SWHO	$73.01	$93.67	$114.33	H H D H H H D D Y
Oiler	EN-324-SWO	$53.42	$67.61	$81.80	H H D H H H D D Y
Tower Crane & Derrick where work is 50' or more	EN-324-SWTD50	$74.74	$96.16	$117.57	H H D H H H D D Y
Tower Crane & Derrick 50' or more w/ Oiler	EN-324-SWTD50-O	$75.84	$97.69	$119.54	H H D H H H D D Y

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Operating Engineer Underground					
Class I Equipment	EN-324A1-UC1	$66.39	$84.19	$101.98	X X X X X X X D Y
	Apprentice Rates:				
	0-999 hours	$52.76	$67.08	$81.41	
	1,000-1,999 hours	$54.80	$70.14	$85.49	
	2,000-2,999 hours	$56.85	$73.22	$89.59	
	3,000-3,999 hours	$58.90	$76.30	$93.69	
	4,000-4,999 hours	$60.94	$79.35	$97.77	
	5,000-5,999 hours	$62.99	$82.43	$101.87	
Class I Equipment - Backfiller Tamper, Backhoe, Batch Plant Operator, Clamshell, Concrete Paver 2 drums or larger, Conveyor Loader Euclid type, Crane (crawler, truck type or pile driving), Dozer, Dragline, Elevating Grader, endloader, gradall, grader, hyd	EN-324A2-UC1	$65.17	$82.61	$100.05	X X X X X X X D Y
	Apprentice Rates:				
	0-999 hours	$49.19	$61.74	$74.29	
	1,000-1,999 hours	$50.99	$64.44	$77.89	
	2,000-2,999 hours	$52.78	$67.12	$81.47	
	3,000-3,999 hours	$54.58	$69.82	$85.07	
	4,000-4,999 hours	$56.37	$72.51	$88.65	
	5,000-5,999 hours	$58.16	$75.19	$92.23	
Class II Equipment - Boom Truck, Crusher, Hoist, Pump 6 inch discharge or larger, side boom tractor, Tractor (pneu-tired other than backhoe or front end loader), Trencher 8 ft. digging capcity and smaller, Vac Truck	EN-324A2-UC2	$60.42	$75.80	$91.17	X X X X X X X D Y
Class III Equipment - Air Compressors 600 cfm or larger, Air Compressors 2 or more less than 600 dfm, Boom Truck non-swinging non-powered type boom, Concrete Breaker self-propelled or truck mounted, Concrete paver 1 drum 1/2 yd. or larger, Elevator other	EN-324A2-UC3	$59.59	$74.61	$89.62	X X X X X X X D Y
Class IV Equipment - Boiler, Concrete Saw 40 hp or over, curing machine self propelled, end dumps, extend a boom forklift, farm tractor with attachment, finishing machine concrete, firemen, hydraulic pipe pushing machine, mulching equipment, oiler, pumps	EN-324A2-UC4	$58.93	$73.66	$88.38	X X X X X X X D Y

GENERAL INFORMATION

Classification Name	Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Painter						
Painter	A 4-10s workweek allowed Monday-Thursday.	PT-845-BR	$40.09	$52.29	$64.49	H H H H H H H D Y
	Apprentice Rates:					
	1st level		$27.89	$33.99	$40.09	
	2nd level		$30.33	$37.65	$44.97	
	3rd level		$33.99	$43.14	$52.29	
	4th level		$37.65	$48.63	$59.61	
Pipe and Manhole Rehab						
General Laborer for rehab work or normal cleaning and cctv work-top man, scaffold man, CCTV assistant, jetter-vac assistant		TM247	$28.20	$38.20	$48.19	H H H H H H H H N
Tap cutter/CCTV Tech/Grout Equipment Operator: unit driver and operator of CCTV; grouting equipment and tap cutting equipment		TM247-2	$32.70	$44.95	$57.19	H H H H H H H H N
CCTV Technician/Combo Unit Operator: unit driver and operator of cctv unit or combo unit in connection with normal cleaning and televising work		TM247-3	$31.45	$43.07	$54.69	H H H H H H H H N
Boiler Operator: unit driver and operator of steam/water heater units and all ancillary equipment associated		TM247-4	$33.20	$45.70	$58.19	H H H H H H H H N
Combo Unit driver & Jetter-Vac Operator		TM247-5	$33.20	$45.70	$58.19	H H H H H H H H N
Pipe Bursting & Slip-lining Equipment Operator		TM247-6	$34.20	$47.20	$60.19	H H H H H H H H N
Plasterer						
Plasterer		CE514-P-L	$45.00	$59.93	$74.85	H H H H H H H D N
	Apprentice Rates:					
	1st Year		$34.55	$44.25	$53.95	
	2nd Year		$37.54	$48.73	$59.93	
	3rd Year		$40.52	$53.21	$65.89	

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Plumber & Pipefitter					
Plumber, Pipefitter and HVACTech Four 10s allowed Monday thru Thursday. Friday not a makeup, considered OT, paid @ time & one-half.	PL-333-RI	$63.77	$95.66	$127.54	H H H H H H H D Y
Apprentice Rates:					
1st 6 months		$41.61	$62.42	$83.22	
2nd 6 months		$43.62	$65.43	$87.24	
3rd 6 months		$45.64	$68.46	$91.28	
4th 6 months		$47.65	$71.48	$95.30	
5th 6 months		$49.67	$74.50	$99.34	
6th 6 months		$51.68	$77.52	$103.36	
7th 6 months		$53.70	$80.55	$107.40	
8th 6 months		$55.71	$83.56	$111.42	
9th 6 months		$57.73	$86.60	$115.46	
10th 6 months		$59.74	$89.61	$119.48	
Roofer					
Commercial Roofer 4 consecutive tens allowed M-TH5 consecutive nine hour days M-F also allowed, time over forty hours per/week shall be at OT. Sat makeup day	RO-70-Z2	$48.36	$63.20	$78.04	H X X X X X X D Y x
Apprentice Rates:					
1st Class		$32.77	$40.27	$47.77	
2nd Class		$34.88	$43.38	$51.88	
3rd Class		$36.77	$46.19	$55.60	
4th Class		$38.90	$49.36	$59.81	
5th Class		$41.05	$52.53	$64.00	
6th Class		$43.15	$55.62	$68.09	
Sewer Relining					
Class I-Operator of audio visual CCTV system including remote in-ground cutter and other equipment used in conjunction with CCTV system.	SR-I	$52.84	$69.23	$85.62	H H H H H H H D N
Apprentice Rates:					
0-6 months		$41.58	$54.66	$67.74	
6-12 months		$45.31	$60.26	$75.20	

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Class II-Operator of hot water heaters and circulation system; water jetters; and vacuum and mechanical debris removal systems and those assisting.	SR-II	$50.80	$68.49	$86.18	H H H H H H H D N
Sheet Metal Worker					
Sheet Metal Worker 4 10s allowed as consecutive days, M-Th or T-F	SHM-7-1	$56.87	$75.25	$93.62	H H H H D D D D Y
	Apprentice Rates:				
	First Year	$30.01	$39.20	$48.39	
	Second Year	$36.34	$47.37	$58.39	
	Third Year	$45.84	$58.70	$71.56	
	Fourth Year	$49.52	$64.22	$78.92	
Sprinkler Fitter					
Sprinkler Fitter	SP 669	$60.34	$78.45	$96.56	H H H H H H H D Y
	Apprentice Rates:				
	Class 1	$24.57	$32.72	$40.87	
	Class 2	$26.38	$35.43	$44.49	
	Class 3	$39.14	$49.10	$59.06	
	Class 4	$40.95	$51.82	$62.68	
	Class 5	$43.01	$54.78	$66.55	
	Class 6	$44.82	$57.49	$70.17	
	Class 7	$46.63	$60.21	$73.79	
	Class 8	$48.45	$62.94	$77.43	
	Class 9	$50.26	$65.65	$81.05	
	Class 10	$52.07	$68.37	$84.67	

GENERAL INFORMATION

Classification Name	Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Tile, Terrazzo and Mosaic Finisher						
Tile, Terrazzo and Mosaic Finisher		BR2-TF	$42.34	$54.17	$65.99	H H H H H H H D N
	Apprentice Rates:					
	1st Period		$35.25	$43.53	$51.81	
	2nd Period		$36.43	$45.30	$54.17	
	3rd Period		$37.61	$47.07	$56.53	
	4th Period		$38.79	$48.84	$58.89	
	5th Period		$39.97	$50.61	$61.25	
	6th Period		$41.16	$52.39	$63.63	
Tile, Terrazzo and Mosaic Setters						
Tile, Terrazzo and Mosaic Setters		BR2-Tile	$48.48	$62.11	$75.73	H H H H H H H D N
	Apprentice Rates:					
	1st Period		$40.31	$49.85	$59.39	
	2nd Period		$41.67	$51.89	$62.11	
	3rd Period		$43.03	$53.93	$64.83	
	4th Period		$44.39	$55.97	$67.55	
	5th Period		$45.75	$58.01	$70.27	
	6th Period		$47.12	$60.07	$73.01	
Tower Technician						
		IBEW 876 & IBEW 17 - Roadway	$67.89	$98.24	$128.58	H H H H H H H D Y
Truck Driver						
of all trucks of 8 cubic yd capacity or over		TM-RB2	$44.10	$48.81	$49.80	H H H H H H H H Y
of all trucks of 8 cubic yard capacity or less (except dump trucks of 8 cubic yard capacity or over, tandem axle trucks, transit mix and semis, euclid type equipment, double bottoms and low boys)		TM-RB2A	$44.00	$48.66	$49.60	H H H H H H H H Y
on euclid type equipment		TM-RB2B	$44.25	$49.04		H H H H H H H H Y

General Request #: 544
Requestor:
Project Description:
Project Number:
County: Ingham

Date Rendered: 2/22/2024

GENERAL INFORMATION

Classification Name / Description		Straight Hourly	Time and a Half	Double Time	Overtime Provision
Truck Driver / Groundman (less than a yr)					
	IBEW 876 & IBEW 17 - Teledata	$30.78	$41.29	$51.79	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	
Truck Driver / Groundman (over 1 yr)					
	IBEW 876 & IBEW 17 - Teledata	$37.40	$50.84	$64.27	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	
TV Terminator - Tech II					
	IBEW 876 & IBEW 17 - Teledata	$38.78	$52.83	$66.87	H H H X X X X D Y
	Apprentice Rates:				
	Lineman (6th - 6 months)	$35.61	$49.90	$64.18	
	Lineman (5th - 6 months)	$33.06	$46.07	$59.08	
	Lineman (4th - 6 months)	$30.53	$42.27	$54.02	
	Lineman (3rd - 6 months)	$27.99	$38.47	$48.94	
	Lineman (2nd - 6 months)	$25.45	$34.66	$43.86	
	Lineman (1st - 6 months)	$22.91	$30.85	$38.78	

STATE OF MICHIGAN

Wage and Hour Division
PO Box 30476
Lansing, MI 48909
517-284-7800

Informational Sheet: Prevailing Wages on State Funded Projects

REQUIREMENTS

Effective February 13, 2024

The purpose of establishing prevailing rates is to provide minimum rates of pay that must be paid to workers on construction projects that are financed or financially supported by the state Prevailing rates compiled from the rates contained in collectively bargained agreements which cover the locations of the state projects. While the prevailing wage rates are compiled through surveys of collectively bargained agreements, a collective bargaining agreement is not required for contractors to be on or be awarded state projects. The prevailing rate schedule provides an hourly rate which includes wage and fringe benefit totals for designated construction mechanic classifications. The overtime rates also include wage and fringe benefit totals. Please pay special attention to the overtime and premium pay requirements. The prevailing wage is satisfied when wages plus fringe benefits are equal to or greater than the required rate.

State of Michigan responsibilities:

- The department establishes the prevailing rate for each classification of construction mechanic requested by the contracting agents prior to contracts being let out for bid on a state project.

DTMB responsibilities

- If a contract is not awarded or construction does not start within 90 days of the date of the issuance of rates, a re- determination of rates must be requested by the contracting agents.
- Rates for classifications needed but not provided on the Prevailing Rate Schedule, ***must*** be obtained ***prior*** to contracts being let out for bid on a state project.

Contractor responsibilities:

- Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing rates prescribed in a contract.
- Every contractor and subcontractor shall keep an accurate record showing the name and occupation of and the actual wages and benefits paid to each construction mechanic. This record shall be available for reasonable inspection by DTMB or the department.
- Each contractor or subcontractor is liable for the payment of the prevailing rate to its employees.
- The prime contractor is responsible for advising all subcontractors of the requirement to pay the prevailing rate prior to commencement of work.
- A construction mechanic *shall only* be paid the apprentice rate if registered with the United States Department of Labor, Bureau of Apprenticeship and Training and the rate is included in the contract.

Enforcement:

A person who has information of an alleged prevailing wage violation on a prevailing wage project may file a complaint with the State of Michigan. The department will investigate and attempt to resolve the complaint informally. During the course of an investigation, if the requested records and posting certification are not made available in compliance with contractual requirements, the Contracting Agent may consider the Contractor to be in material breach of the contract and may terminate the contract for cause at the sole discretion. There are also civil penalties for failure to be in compliance with Act 10. View the entire text of Act 10 of 2023 at michigan.gov/wagehour.

STATE OF MICHIGAN

Informational Sheet: Prevailing Wages on State Projects

General Information Regarding Fringe Benefits

Certain fringe benefits **may** be credited toward the payment of the Prevailing Wage Rate:

- If a fringe benefit is paid directly to a construction mechanic
- If a fringe benefit contribution or payment is made on behalf of a construction mechanic
- If a fringe benefit, which may be provided to a construction mechanic**,** is pursuant to a written contract or policy
- If a fringe benefit is paid into a fund, for a construction mechanic

When a fringe benefit is not paid by an hourly rate, the hourly credit will be calculated based on the annual value of the fringe benefit divided by 2080 hours per year (52 weeks @ 40 hours per week). The following is an example of the types of fringe benefits allowed and how an hourly credit is calculated:

Vacation	40 hours X $14.00 per hour = $560/2080 =	$.27
Dental insurance	$31.07 monthly premium X 12 mos. = $372.84 /2080 =	$.18
Vision insurance	$5.38 monthly premium X 12 mos. = $64.56/2080 =	$.03
Health insurance	$230.00 monthly premium X 12 mos. = $2,760.00/2080 =	$1.33
Life insurance	$27.04 monthly premium X 12 mos. = $324.48/2080 =	$.16
Tuition	$500.00 annual cost/2080 =	$.24
Bonus	4 quarterly bonus/year x $250 = $1000.00/2080 =	$.48
401k Employer Contribution	$2000.00 total annual contribution/2080 =	$.96
	Total Hourly Credit	$3.65

Other examples of the types of fringe benefits allowed:

- Sick pay
- Holiday pay
- Accidental Death & Dismemberment insurance premiums

The following are examples of items that **will not** be credited toward the payment of the Prevailing Wage Rate

- Legally required payments, such as:
  - Unemployment Insurance payments
  - Workers' Compensation Insurance payments
  - FICA (Social Security contributions, Medicare contributions)
- Reimbursable expenses, such as:
  - Clothing allowance or reimbursement
  - Uniform allowance or reimbursement
  - Gas allowance or reimbursement
  - Travel time or payment
  - Meals or lodging allowance or reimbursement
  - Per diem allowance or payment
- Other payments to or on behalf of a construction mechanic that are not wages or fringe benefits, such as:
  - Industry advancement funds
  - Financial or material loans

OVERTIME PROVISIONS for MICHIGAN PREVAILING WAGE RATE COMMERCIAL SCHEDULE

1. Overtime is represented as a nine character code. Each character represents a certain period of time after the first 8 hours Monday thru Friday.

	Monday thru Friday	Saturday	Sunday & Holidays	Four 10s
First 8 Hours		**4**	**8**	**9**
9th Hour	**1**	**5**		
10th Hour	**2**	**6**		
Over 10 hours	**3**	**7**		

Overtime for Monday thru Friday after 8 hours:
the 1st character is for time worked in the 9th hour *(8.1 - 9 hours)*
the 2nd character is for time worked in the 10th hour *(9.1 - 10 hours)*
the 3rd character is for time worked beyond the 10th hour *(10.1 and beyond)*

Overtime on Saturday:
the 4th character is for time worked in the first 8 hours on Saturday *(0 - 8 hours)*
the 5th character is for time worked in the 9th hour on Saturday *(8.1 - 9 hours)*
the 6th character is for time worked in the 10th hour *(9.1 - 10 hours)*
the 7th character is for time worked beyond the 10th hour *(10.01 and beyond)*

Overtime on Sundays & Holidays
The 8th character is for time worked on Sunday or on a holiday

Four Ten Hour Days
The 9th character indicates if an optional 4-day 10-hour per day workweek can be worked ***between Monday and Friday*** **without paying overtime after 8 hours worked, unless otherwise noted in the rate schedule. To *utilize a 4 ten workweek, notice is required from the employer to employee prior to the start of work on the project.***

2. Overtime Indicators Used in the Overtime Provision:
   H - means TIME AND ONE-HALF due
   X - means TIME AND ONE-HALF due after 40 HOURS worked
   D - means DOUBLE PAY due
   Y - means YES an optional 4-day 10-hour per day workweek can be worked without paying overtime after 8 hours worked
   N - means NO an optional 4-day 10-hour per day workweek *cannot* be worked without paying overtime after 8 hours worked

3. EXAMPLES:
   HHHHHHHDN - This example shows that the 1½ rate must be used for time worked after 8 hours Monday thru Friday *(characters 1 - 3);* for all hours worked on Saturday, 1½ rate is due *(characters 4 - 7).* Work done on Sundays or holidays must be paid double time *(character 8).* The N *(character 9)* indicates that 4 ten-hour days is not an acceptable workweek at regular pay.

   XXXHHHHDY - This example shows that the 1½ rate must be used for time worked after 40 hours are worked Monday thru Friday *(characters 1-3);* for hours worked on Saturday, 1½ rate is due *(characters 4 – 7)*. Work done on Sundays or holidays must be paid double time *(character 8).* The Y *(character 9)* indicates that 4 ten-hour days is an acceptable alternative workweek.

ENGINEERS - CLASSES OF EQUIPMENT LIST

UNDERGROUND ENGINEERS

CLASS I

Backfiller Tamper, Backhoe, Batch Plant Operator, Clam-Shell, Concrete Paver (2 drums or larger), Conveyor Loader (Euclid type), Crane (crawler, truck type or pile driving), Dozer, Dragline, Elevating Grader, End Loader, Gradall (and similar type machine), Grader, Power Shovel, Roller (asphalt), Scraper (self propelled or tractor drawn), Side Broom Tractor (type D-4 or larger), Slope Paver, Trencher (over 8' digging capacity), Well Drilling Rig, Mechanic, Slip Form Paver, Hydro Excavator.

CLASS II

Boom Truck (power swing type boom), Crusher, Hoist, Pump (1 or more 6" discharge or larger gas or diesel powered by generator of 300 amps or more, inclusive of generator), Side Boom Tractor (smaller than type D-4 or equivalent), Tractor (pneu-tired, other than backhoe or front end loader), Trencher (8' digging capacity and smaller), Vac Truck.

CLASS III

Air Compressors (600 cfm or larger), Air Compressors (2 or more less than 600 cfm), Boom Truck (non-swinging, non-powered type boom), Concrete Breaker (self-propelled or truck mounted, includes compressor), Concrete Paver (1 drum, ½ yard or larger), Elevator (other than passenger), Maintenance Man, Mechanic Helper, Pump (2 or more 4" up to 6" discharge, gas or diesel powered, excluding submersible pump), Pumpcrete Machine (and similar equipment), Wagon Drill Machine, Welding Machine or Generator (2 or more 300 amp or larger, gas or diesel powered).

CLASS IV

Boiler, Concrete Saw (40HP or over), Curing Machine (self-propelled), Farm Tractor (w/attachment), Finishing Machine (concrete), Firemen, Hydraulic Pipe Pushing Machine, Mulching Equipment, Oiler (2 or more up to 4", exclude submersible), Pumps (2 or more up to 4" discharge if used 3 hrs or more a day-gas or diesel powered, excluding submersible pumps), Roller (other than asphalt), Stump Remover, Vibrating Compaction Equipment (6' wide or over), Trencher (service) Sweeper (Wayne type and similar equipment), Water Wagon, Extend-a-Boom Forklift.

HAZARDOUS WASTE ABATEMENT ENGINEERS

CLASS I

Backhoe, Batch Plant Operator, Clamshell, Concrete Breaker when attached to hoe, Concrete Cleaning Decontamination Machine Operator, Concrete Pump, Concrete Paver, Crusher, Dozer,
Elevating Grader, Endloader, Farm Tractor (90 h.p. and higher),
Gradall, Grader, Heavy Equipment Robotics Operator, Hydro Excavator, Loader, Pug Mill, Pumpcrete Machines, Pump Trucks, Roller, Scraper (self-propelled or tractor drawn), Side Boom Tractor, Slip Form Paver, Slope Paver, Trencher, Ultra High Pressure Waterjet Cutting Tool System Operator, Vactors, Vacuum Blasting Machine Operator, Vertical Lifting Hoist, Vibrating Compaction Equipment (self-propelled), and Well Drilling Rig.

CLASS II

Air Compressor, Concrete Breaker when not attached to hoe, Elevator, End Dumps, Equipment Decontamination Operator, Farm Tractor (less than 90 h.p.), Forklift, Generator, Heater, Mulcher, Pigs (Portable Reagent Storage Tanks), Power Screens, Pumps (water), Stationary Compressed Air Plant, Sweeper, Water Wagon and Welding Machine.

CARPENTER CRAFT JURISDICTION

Michigan recognizes the Carpenters for any and all work related to weatherization that has historically been the work of the Carpenter. This work shall include, but not be limited to: all work defined under the Federal Weatherization Assistance Program.

The jurisdiction of Carpenters, as to all work that has historically and traditionally been performed consisting of the milling, fashioning, joining, assembling, erecting, fastening or dismantling of all materials of wood, plastic, metal, fiber, cork, or composition and all other substitute materials, as well as the handling, cleaning, erecting, installing and dismantling of all machinery, equipment and all materials used by Carpenters.

The jurisdiction, therefore, extends over the following divisions and subdivisions of the trade: Carpenters and Joiners, Millwrights, Pile Drivers, Bridge, Dock and Wharf Carpenters, Underpinners, Timbermen, and Core-drillers, Shipwrights, Boat Builders, Ship- hand, Stair-Builders, Millmen, Wood and Resilient Floor Decorators, Floor Finishers, Carpet-layers, Shinglers, Siders, Insulators, Acoustic and Drywall Applicators, Sharers and House Movers, Loggers, Lumber and Sawmill Workers, Reed and Rattan Workers, Shingle Weavers, Casket and Coffin Makers, Railroad Carpenters and Car Builders, regardless of material used and all those engaged in the operation of woodworking or other machinery required in fashioning, milling or manufacturing of products used in the trade, and the handling, erecting and installing materials on any of the above divisions or sub-divisions, burning, welding and rigging incidental to the trade. When the term "Carpenter and Joiner" is used, it shall mean all the subdivisions of the trade. The trade autonomy of Carpenters therefore extends over the divisions and subdivisions of the trade, which are set forth as follows:

(a) The framing, erecting and prefabrication of roofs, partitions, floors and other parts of buildings of wood, metal, plastic or other substitutes; application of all metal flashing used for hips, valleys and chimneys; the erection of Stran Steel section or its equal. The building and setting of all forms and centers for brick and masonry. The fabrication and erection of all forms for concrete and decking, the dismantling of same (as per International Agreement) when they are to be re-used on the job or stored for re-use. The cutting and handling of all falsework for fireproofing and slabs. Where power is used in the setting or dismantling of forms, all signaling and handling shall be done by carpenters. The setting of templates for anchor bolts for structural members and for machinery, and the placing, leveling and bracing of these bolts. All framing in connection with the setting or metal columns. The setting of all bulkheads, footing forms and the setting of and fabrication of, screeds and stakes for concrete and mastic floors where the screed is notched or fitted, or made up of more than one member. The making of forms for concrete block, bulkheads, figures, posts, rails, balusters and ornaments, etc.

(b) The handling and erecting of rough material and drywall, the handling, assembly, setting and leveling of all fixtures, display cases, all furniture such as tables, chairs, desks, coat racks, etc., all de-mountable or moveable partitions such as Von wall, E Wall, Steel Case, Herman Miller, Haworth, American Seating, Westinghouse, Lazy Boy, rosewood, etc. All rebuilding, remodeling and setting up of all kinds of partitions, finished lumber, metal and plastic trim to be erected by Carpenters shall be handled from the truck or vehicle delivering same to the job by Carpenters.

CARPENTER CRAFT JURISDICTION

(c) The building and moving of all scaffolding runways and staging where carpenters' tools are used, the building from the ground up of all scaffolds over fourteen (14) feet in height including metal and specially designed scaffolding. The building and construction of all hoists and derricks made of wood; the making of mortar boards, boxes, trestles, all shoring, razing and moving of buildings. Lift type trucks are to be considered a tool of the trade. Metal siding and metal roofing fall within the scope of jurisdiction for the carpenters.

(d) The cutting or framing and fireproofing of the openings for pipes, conduits, ducts, etc., where they pass through floors, partitions, walls, roofs or fixtures composed in whole or in part of wood. The laying out of making and installation of all inserts and sleeves for pipes, ducts, etc., where carpenters' tools and knowledge are required. The making and installing of all wooden meter boards, crippling and backing for fixtures. The welding of studs and other fastenings to receive material being applied by carpenters.

(e) The installation of all grounds, furring or stripping, ceilings and sidewalks, application of all types of shingling and siding, etc.

(f) The installation of all interior and exterior trim or finish of wood, aluminum, kalamein, hollow or extruded metal, plastic, doors, transoms, thresholds, mullions and windows. The setting of jambs, bucks, window frames of wood or metal where braces or wedges are used. The installation of all wood, metal or other substitutes of casing, molding, chair rail, wainscoting, china closets, base of mop boards, wardrobes, metal partitions as per National Decisions or specific agreements, etc. The complete laying out, fabrication and erection of stairs. The making and erecting of all fixtures, cabinets, shelving, racks, louvers, etc. The mortising and application of all hardware in connection with our work. The sanding and refinishing of all wood, cork or composition floors to be sanded or scraped, filled, sized and buffed, either by hand or power machines. The assembling and setting of all seats in theaters, halls, churches, schools, auditorium, grandstands and other buildings. All bowling alley work.

(g) The manufacture, fabrication and installation of all screens, storm sash, storm doors and garage doors; the installation of wood, canvas, plastic or metal awnings or eye shades, door shelters, jalousies, etc. The laying of wood, wood block and wood composition in floors.

(h) The installation of all materials used in drywall construction, such as plasterboard, all types of asbestos boards, transite and other composition board. The application of all material which serves as base for acoustic tile, except plaster. All acoustical applications as per National Agreement or specific agreement.

(i) The building and dismantling of all barricades, hand rails, guard rails, partitions and temporary partitions. The erection and dismantling of all temporary housing on construction projects.

(j) The installation of rock wool, cork and other insulation material used for sound or weatherproofing. The removal of caulking and placing of staff bead and brick mold and all Oakum caulking, substitutes, etc., and all caulking in connection with carpentry work.

(k) The installation of all chalk boards/marker boards.

CARPENTER CRAFT JURISDICTION

(l) The operation of all hand operated winches used to raise wooden structures.

(m) The erection of porcelain enameled panels and siding.

(n) The unloading and distribution of all furnished, prefabricated and built-up sections such as door bucks, window frames, cupboards, cabinets, store fixtures, counters and show cases or comparably finished or prefabricated materials, to the job sites or points of installation as used in the construction, alteration and remodeling industry.

(o) The handling of doors, metal, wood or composite, partitions and other finished bulk materials used for trim from the point of delivery.

(p) All processing of these materials and handling after processing.

(q) The making up of panels and fitting them into walls, all bracing and securing, all removal of panels from the casting including all braces, whalers, hairpins, etc.

(r) The handling and setting of all metal pans and sections from the stock piles of reasonable distance as required by job needs shall be performed by carpenters. The stripping of such metal pans, panels or sections is to be performed by carpenters.

(s) The sharpening of all carpenter hand or power tools, or those used by carpenters.

(t). The layout, fabrication, assembling of and erection and dismantling of all displays made of wood, metal, plastic, composition board or any substitute material; the covering of same with any type of material, the crating and un-crating, the handling from the point of unloading and back to the point of loading of all displays and other materials or components.

(u) The same shall apply to all other necessary component parts used for display purposes such as turntables, platforms, identification towers and fixtures, regardless of how constructed, assembled or erected or dismantled.

(v) The make-up, handling, cutting and sewing of all materials used in buntings, flags, banners, decorative paper, fabrics and similar materials used in the display decorative industry for draperies and back drops. The decorative framing of trucks, trailers and autos used as floats or moving displays. The slatting of walls to hand fabrics and other decorative materials, drilling of all holes to accommodate such installations. Setting up and removal of booths constructed of steel or aluminum tubing as stanchions, railings, etc., handling and placing of furniture, appliances, etc., which are being used to complete the booth at the request of the exhibitor. Fabricating and application of leather, plastic and other like materials used for covering of booths. The handling of all materials, fabricating of same. The loading and unloading, erecting and assembling at the exhibit of show area, also in or out of storage when used in booth decorations.

CARPENTER CRAFT JURISDICTION

(w) A display shall be construed as any exhibit or medium of advertising, open to private or public showing, which is constructed of wood, metal, plastic or any other substitute to accomplish the objectives of advertising or displaying.

(x) Handling, fitting, draping, measuring and installation of fixtures and other hardwares for draperies, all manner of making, measuring, repairing, sizing, hanging and installation of necessary fixtures and hardware for shades and Venetian blinds.

(y) Work consisting of cutting and/or forming of all materials in preparation for installing of floors, walls and ceilings; the installation of all resilient floor and base; wall and ceiling materials to include cork, linoleum, prefabricated, laminated, rubber, asphalt, vinyl, metal, plastic, seamless floors and all other similar materials in sheet, interlocking liquid or tile form; the installation of all artificial turf, the installation, cutting and/or fitting of carpets; installation of padding, matting, linen crash and all preformed resilient floor coverings; the fitting of all devices for the attachment of carpet and other floor, wall and ceiling coverings; track sewing of carpets, drilling of holes for sockets and pins, putting in dowels and slats; and all metal trimmings used; the installation of all underlayments, sealants in preparation of floors, walls and ceilings, the unloading and handling of all materials to be installed and the removal of all materials in preparing floors when contracted for by the employer, shall be done only by employees covered under this Agreement.

(z) The installation of all sink-tops and cabinets, to include all metal trim and covering for same. All cork, linoleum, congo-wall, linewall, veos tile, plexiglass, vinawall tile, composition tile, plastic tile, aluminum tile and rubber in sheets or tile form and the application thereof. All bolta-wall and bolta-wall tile and similar products.

(aa) The handling and placing of all pictures and frames and the assembly of bed frames and accessories. The hanging and placing of all signage.

(bb) The installation of all framework partitions and trim materials for toilets and bathrooms made of wood, metal, plastics or composition materials; fastening of all wooden, plastic or composition cleats to iron or any other material for accessories.

(cc) The erection of cooling towers and tanks.

(dd) The setting, lining, leveling and bracing of all embedded plates, rails and angles. The setting of all stay in place forms.

(ee) Environmental: Clean room, any type of environmental chamber, walk in refrigerated coolers and all refrigerated rooms or buildings.

CARPENTER CRAFT JURISDICTION

PILE DRIVING AND CAISSON DRILLING

(ff) All unloading, handling, signaling and driving of piles, whether wood, steel, pipe, beam pile, composite, concrete or molded in place, wood and steel sheeting, cofferdam work, trestle work, dock work, floating derricks, caisson work, foundation work, bridge work, whether old or new, crib work, pipe line work and submarine work. Cutting of all wood, steel or concrete pile, whether by machine or hand; welding and cutting, peeling, and heading of all wood pile, steel sheeting and wood sheeting. The erecting and dismantling of all pile driving rigs, also derricks whether on land or water; also the moving, shoring and underpinning of all buildings. The loading and unloading of all derricks, cranes and pile driving materials. The tending, maintenance and operation of all valves pertaining to the operation of driving of pile. All diving and tending essential to the completion of jurisdictional claims.

All work done in the established yards of the Company and all work not enumerated above, shall be handled and manned as the Employer decides.

The pile driver will unload all material shipped in by rail from the point that the rail car is spotted.

All cleaning and preparation of all piling prior to driving.

The welding and attachment of all boot plates, pile points, splice plates, connectors, rock crosses, driving crosses, driving rigs, point reinforcements and overboots.

The construction, reconstruction, repair, alteration, demolition and partial or complete removal of all marine work including, but not limited to, docks, piers, wharves, quays, jetties, cribs, causeways, breakwaters, lighthouses and permanent buoys, etc. (mixing and placing of concrete excepted).

The driving and pulling of all wood, steel and concrete foundation piles and sheet piling.

The heading, pointing, splicing, cutting and welding of all piles.

The placing of all wales, bolts, studs, lagging, rods and washers including the cutting, drilling, boring or breaking of all holes or openings thereof.

The removal of all materials and/or obstructions of any nature (rip-rap included) that retard or interfere with the driving of piles or with the placing of wales, bolts and rods.

CARPENTER CRAFT JURISDICTION

This is to be subject to the discretion of the contractor who may choose to use blasting specialists or other demolition specialists.

The handling on the job of all materials used in the work.

The manning of all floating equipment (towing equipment excepted) engaged in the work enumerated, including deck engines, except machinery manned by Operating Engineers.

The placing of all rip-rap, fill stone, bedding stone, cover stone and concrete blocks in connection with marine construction. Work normally performed by Employers, such as soil tests, shoring, underpinning of buildings, cribbing, driving of sheet piling, marine divers, tenders, underwater construction workers and similar operations shall continue to be included in the jurisdiction of this Agreement.

All burning, cutting, welding and fabrication of pipe, H-beams, sheet pile (metal or wood), done on the job site or in the yard of the Employer shall be done by pile drivers. The driving of bearing piles, sheet piling with heavy equipment, caissons, pile caps, auger drilling and boring, the setting up for load testing for any type of piling, all layout and spotting for piling, caisson and boring work, all earth retention, ditch boarding, installing tiebacks.

ASBESTOS ABATEMENT CARPENTERS

(gg) All erection and maintenance of barriers and partitions used in the removing of asbestos or any abatement work. The abatement of any materials previously installed by the carpenter such as transite, ceiling and floor tiles. All operating and maintaining of current equipment used in any abatement work.

ELECTRICIAN – SOUND AND COMMUNICATION / DATA/ VOICE JURISDICTION

The installation, testing, service and maintenance, of systems which utilize the transmission and/or transference of voice, sound, vision or digital for commercial, education, security and entertainment purposes for the following: TV monitoring and surveillance, CATV and CCTV, background-foreground music, intercom and telephone interconnect, inventory control systems, microwave transmission, multi-media, multiplex, radio page, school intercom and sound, burglar alarms, low voltage fire alarm systems, low voltage master clock systems, distributed antenna systems (DAS), IP data networks, and all surface-mounted (non-power) telecommunications wiremold. Shall additionally include the installation of all raceway systems of unlimited length in telecommunications rooms, entrance facilities, equipment rooms, and similar areas. Energy management systems. Security systems; perimeter, vibration, card access, access control and sonar/infrared monitoring equipment. Communications systems that transmit or receive information and/or control systems that are intrinsic to the above listed systems; SCADA (Supervisory Control and Data Acquisition), PCM (Pulse Code Modulation), Digital Data Systems, Broadband and Baseband and Carriers, POS (Point of Sale systems), VSAT Data Systems, RF and Remote Control Systems, Fiber Optic Data Systems and Voice and Data Infrastructure and Backbone.

MICHIGAN STATE
UNIVERSITY

SPECIFICATION FOR

LIFE SCIENCE – RENOVATIONS TO ROOM B108A

MSU PROJECT NUMBER CP23077

Friday, February 16, 2024

AT

MICHIGAN STATE UNIVERSITY
EAST LANSING, MICHIGAN

Infrastructure Planning and Facilities
Planning, Design and Construction

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SECTION 003134 – HAZARDOUS MATERIALS INSPECTION REPORT

Beginning of Hazardous Materials Test Results

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Project # 21043-1 Date 7/28/05 - 8/10/05

Building Life Science Floor 1st

Room #/Area Description	Material Description	Condition	Homogenous Area #	Asbestos Containing (Y) Yes (N) No	Quantity	Unit
B107, B107A	Plaster (smooth)	Undamaged	4	N	450	s.f.
B107, B107A	Drywall	Undamaged	44	N	450	s.f.
B107, B107A	2' x 2' white lay-in textured ceiling tile with pin holes	Undamaged	42	N	500	s.f.
B107, B107A	4" gray cove molding and associated mastic	Undamaged	41	N	70	l.f.
B107, B107A	12" x 12" white floor tile with mosaic pattern and associated mastic	Undamaged	39	N	500	s.f.
B107, B107A	White sink undercoating insulation	Undamaged	40	N	2	ct.

Project # 21043-1 Date 7/28/05 - 8/10/05

Building Life Science Floor 1st

Room #/Area Description	Material Description	Condition	Homogenous Area #	Asbestos Containing (Y) Yes (N) No	Quantity	Unit
B108A	Plaster (smooth)	Undamaged	4	N	538	s.f.
B108A	Drywall	Undamaged	44	N	538	s.f.
B108A	4" gray cove molding and associated mastic	Undamaged	41	N	75	l.f.
B108A	12" x 12" white floor tile with mosaic pattern and associated mastic	Undamaged	39	N	345	s.f.

Project # 21043-1 Date 7/28/05 - 8/10/05

Building Life Science Floor 1st

Room #/Area Description	Material Description	Condition	Homogenous Area #	Asbestos Containing (Y) Yes (N) No	Quantity	Unit
B108B	Plaster (smooth)	Undamaged	4	N	565	s.f.
B108B	Drywall	Undamaged	44	N	565	s.f.
B108B	4" gray cove molding and associated mastic	Undamaged	41	N	56	l.f.
B108B	2' x 2' white lay-in ceiling tile with pin holes and fissures	Undamaged	22	N	212	s.f.

Project # 21043-1 Date 7/28/05 - 8/10/05

Building Life Science Floor 1st

Room #/Area Description	Material Description	Condition	Homogenous Area #	Asbestos Containing (Y) Yes (N) No	Quantity	Unit
B108C	Plaster (smooth)	Undamaged	4	N	320	s.f.
B108C	Drywall	Undamaged	44	N	320	s.f.
B108C	4" gray cove molding and associated mastic	Undamaged	41	N	40	l.f.
B108C	12" x 12" white floor tile with mosaic pattern and associated mastic	Undamaged	39	N	126	s.f.

Project # 21043-1 Date 7/28/05 - 8/10/05

Building Life Science Floor 1st

Room #/Area Description	Material Description	Condition	Homogenous Area #	Asbestos Containing (Y) Yes (N) No	Quantity	Unit
Hall, B108E	Plaster (smooth)	Undamaged	4	N	480	s.f.
Hall, B108E	Drywall	Undamaged	44	N	480	s.f.
Hall, B108E	4" gray cove molding and associated mastic	Undamaged	41	N	48	l.f.
Hall, B108E	2' x 2' white lay-in textured ceiling tile with pin holes	Undamaged	42	N	201	s.f.

Project # 21043-1 Date 7/28/05 - 8/10/05

Building Life Science Floor 1st

Room #/Area Description	Material Description	Condition	Homogenous Area #	Asbestos Containing (Y) Yes (N) No	Quantity	Unit
B120	Plaster (smooth)	Undamaged	4	N	300	s.f.
B120	Spray-on fireproofing insulation	Undamaged	1	Y	742	s.f.
B120	Drywall	Undamaged	44	N	300	s.f.
B120	4" cream cove molding and associated mastic	Undamaged	9	N	125	l.f.
B120	9" x 9" gray floor tile with cream and gray streaks and associated mastic	Undamaged	8	Y	742	s.f.
B120	Steam/condensate supply and return pipe joint and hanger insulation	Undamaged	5	Y	15	ct.
B120	Domestic water supply and return pipe joint and hanger insulation	Undamaged	6	Y	15	ct.

Project # 21043-1 Date 7/28/05 - 8/10/05

Building Life Science Floor 1st

Room #/Area Description	Material Description	Condition	Homogenous Area #	Asbestos Containing (Y) Yes (N) No	Quantity	Unit
B123	Plaster (smooth)	Undamaged	4	N	495	s.f.
B123	Spray-on fireproofing insulation	Undamaged	1	Y	742	s.f.
B123	Drywall	Undamaged	44	N	495	s.f.
B123	4" cream cove molding and associated mastic	Undamaged	9	N	100	l.f.
B123	9" x 9" gray floor tile with cream and gray streaks and associated mastic	Undamaged	8	Y	742	s.f.
B123	Black laboratory sink and table tops	Undamaged	14	Assumed	7	ct.
B123	Transite ventilation hoods	Undamaged	32	Assumed	1	ct.

Notes: Mechanical shaft present? N Pipe chase present? N

Fibertec Industrial Hygiene Services, Inc.

ROOM BY ROOM ASBESTOS BUILDING INSPECTION FORM

Project # 21043-1 Date 7/28/05 - 8/10/05

Building Life Science Floor 1st

Room #/Area Description	Material Description	Condition	Homogenous Area #	Asbestos Containing (Y) Yes (N) No	Quantity	Unit
B123A	Plaster (smooth)	Undamaged	4	N	220	s.f.
B123A	Spray-on fireproofing insulation	Undamaged	1	Y	120	s.f.
B123A	Drywall	Undamaged	44	N	220	s.f.
B123A	4" cream cove molding and associated mastic	Undamaged	9	N	31	l.f.
B123A	9" x 9" gray floor tile with cream and gray streaks and associated mastic	Undamaged	8	Y	120	s.f.

Notes: Mechanical shaft present? N Pipe chase present? N

Fibertec Industrial Hygiene Services, Inc.

ROOM BY ROOM ASBESTOS BUILDING INSPECTION FORM

Project # 21043-1 Date 7/28/05 - 8/10/05

Building Life Science Floor 1st

Room #/Area Description	Material Description	Condition	Homogenous Area #	Asbestos Containing (Y) Yes (N) No	Quantity	Unit
B123B	Plaster (smooth)	Undamaged	4	N	225	s.f.
B123B	Spray-on fireproofing insulation	Undamaged	1	Y	123	s.f.
B123B	Drywall	Undamaged	44	N	225	s.f.
B123B	4" cream cove molding and associated mastic	Undamaged	9	N	41	l.f.
B123B	9" x 9" gray floor tile with cream and gray streaks and associated mastic	Undamaged	8	Y	123	s.f.

Notes: Mechanical shaft present? N Pipe chase present? N

Fibertec Industrial Hygiene Services, Inc.

ROOM BY ROOM ASBESTOS BUILDING INSPECTION FORM

Project # 21043-1 Date 7/28/05 - 8/10/05

Building Life Science Floor 1st

Room #/Area Description	Material Description	Condition	Homogenous Area #	Asbestos Containing (Y) Yes (N) No	Quantity	Unit
First Floor Halls "B" Wing	Spray-on fireproofing insulation	Undamaged	1	Y	3,500	s.f.

Notes: Mechanical shaft present? N Pipe chase present? N

END OF SECTION 003134

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SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Alternate Work shall include miscellaneous devices, accessories and other items incidental to or required for a complete installation whether or not indicated as part of the alternate.

B. Base bid amounts shall be in accordance with the Bid Documents and shall not include additional or deducted costs for alternates.

C. Cost for Labor and Material Performance and Payment Bonds, if such bonds are required by the Contract Documents, shall be included in the cost of the alternate.

1.2 VOLUNTARY ALTERNATES

A. Bidders may propose alternative materials to those specified in the form of a Voluntary Alternate.

B. Proposals for voluntary alternates shall accompany the base bid proposal with additional cost to or cost to be deducted from the base bid amount. Voluntary Alternate costs shall not be included in the base bid amount.

1.3 SPECIFIED ALTERNATES

A. Alternate material or Work to the base bid is itemized and described in this section and in the Contract Documents.

B. Bidders shall carefully review the proposed alternate to be fully informed as to the material, incidental material and Work to be performed. Bidder shall not later than five (5) days prior to the date for receipt of bids, make written request for interpretation or correction of any ambiguity, inconsistency or error discovered.

C. Each bidder shall submit with his proposal in the space provided on the Bid Proposal Form alternate proposals stating the additions to or deductions from the base bid lump sum amount for substituting, omitting, adding, changing, or altering materials, equipment or construction from that indicated on the Drawings and/or Specifications.

D. The Owner and Construction Manager reserve the right to waive any irregularities, reject, any or all alternates, which in its opinion serve the Owner's best interest.

1.4 SUMMARY OF REQUESTED ALTERNATES

A. Alternate 1 – Renovation of Corridor 1HW3 (Deduct):

1. Associated Drawings: A-002, A-003, A-004, A-005, A-006, A-007, A-008, A-009, E-002, E-004, E-005, E-006, E-007, FP-001, M-004, M-005, DA-001, DE-001, DE-002, DM-001, DM-002: Existing Corridor 1HW3 to remain unchanged.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 012300

SECTION 024119 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the modification, alteration, conversion, and renovation of existing structures:
   1. Be aware of the many incidental items which exist which must be demolished, relocated, or replaced in order to accomplish the remodeling work of trades.
   2. Include the price of such demolition, relocating, and replacement in the base Bid.
   3. These incidental items may or may not be indicated in the Contract Documents.
   4. Contractor and Subcontractors performing remodeling work are expected to be familiar with the unknown nature of existing utilities serving an area to be remodeled and shall calculate the base Bid to include the demolition, removal, relocation, and replacement of these utilities.

1.3 REFERENCES

A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the pertinent provisions of the following:
   1. American National Standards Institute: ANSI A10.6 - Safety Requirements for Demolition Operations.
   2. ASTM: D1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort.
   3. EPA: Rule 406(b) of the Toxic Substances Control Act of 1992.
   4. NFPA: NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.4 DEFINITIONS

A. Terms:
   1. Abandon:
      a. Remove an item to the extent that it is not visible and does not interfere with new construction.
      b. Portions of the abandoned item may be left in place.
      c. No abandoned items shall be left below new footings.
   2. Demolish:
      a. Remove existing items from their present location in the Project area and haul to an area outside of the Project area.
      b. Remove utilities serving these items.
   3. Relocate:
      a. Move existing items from their present location to another location in the Project area.
      b. Extend utilities serving the present location to the new location.

4. Remove:
    a. Except for items indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property.
    b. Remove existing items from their present location in the Project area and haul to an area outside of the Project area.
    c. Remove utilities serving these items.
5. Replace:
    a. Remove existing items from their present location in the Project area, haul them to an area outside of the Project area, and furnish and install new items in the same or another location.
    b. Extend utilities serving the present location to the new location.
6. Reuse: Move existing items from their present location to another location in the Project area. Extend utilities serving the present location to the new location.
7. Historic Items:
    a. Historic items, relics, and similar object including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property.
    b. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.5 DIVISION OF WORK

A. Work: In accordance with the General Conditions, the Construction Manager is responsible for dividing the Work among the Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of the work:
    1. Contractor:
        a. Cut and patch walls, floors, and ceilings to allow for recessed utilities and ductwork.
        b. Remove existing suspended ceilings to allow for above ceiling construction.
        c. Replace damaged units.
        d. Install new ceilings as indicated on the Drawings.
        e. Install fire stop and smoke stop systems at penetrations for ratings indicated in accordance with local building codes.
    2. Mechanical, Electrical, Plumbing and Fire Protection Subcontractors:
        a. Install fire stop and smoke stop systems at utility penetrations in accordance with local building codes.
        b. Furnish and install sleeves in gypsum board and masonry construction.
        c. Core drill existing concrete for new utilities and sleeves after obtaining Engineer's review of locations.
        d. Remove and reinstall existing fire protection heads to allow for ceiling removal and installation.
        e. Furnish new heads, piping, and connections as required for completion of the Work.
    3. Miscellaneous:
        a. Each trade shall be financially responsible for cutting and patching for sleeves, penetrations, and installation of isolated components as necessary for its work unless herein specifically stated to the contrary.
        b. On renovation projects, cut and patch walls, floors, and ceilings to allow for continuous runs of recessed utilities and ductwork.
        c. Patching shall be done by the trade whose work is damaged.

d. Costs caused by defective or ill-timed work shall be borne by the party responsible.
e. Each trade shall do fitting of its own work as required to make its several components fit together or to receive the work of other trades.

1.6 SUBMITTALS

A. Pre-demolition Photographs:
1. Submit showing existing conditions of construction to remain that could be misconstrued as damage caused by construction activities.
2. Including building and Site, as well as interior and exterior finishes.
3. Submit prior to commencing Work.

1.7 QUALITY ASSURANCE

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

B. Regulatory Requirements:
1. Comply with governing EPA notification regulations before beginning selective demolition.
2. Comply with hauling and disposal regulations of authorities having jurisdiction.
3. Comply with ANSI A10.6 and NFPA 241.
4. Comply with 29 CFR 1926.62-(OSHA Paint Standard).

C. Pre-Demolition Conference:
1. Conduct pre-demolition conference at Site.
2. Review methods and procedures related to selective demolition including, but not limited to, the following:
a. Inspect and discuss condition of construction to be selectively demolished.
b. Review structural load limitations of existing structure.
c. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and to avoid delays.
d. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.8 PROJECT CONDITIONS

A. Owner Occupancy:
1. Owner will occupy portions of building immediately adjacent to selective demolition area.
2. Conduct selective demolition so Owner’s operations will not be disrupted.
3. Exact timing of building system shutdowns to be coordinated with the Owner, but assume those shut downs will occur between 12 a.m. and 5 a.m.
4. Provide not less than 72-hour notice to Owner of activities that will affect Owner’s operations.

B. Access:
1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
2. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

C. Conditions:
   1. Owner and Engineer assume no responsibility for condition of areas to be selectively demolished.
   2. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as far as practicable.

D. Storage or sale of removed items or materials on Site will not be permitted.

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

F. Known Hazardous Materials:
   1. Hazardous materials are present in building to be selectively demolished.
   2. A report on the known hazardous materials is on file for review and use.
   3. Examine report to become aware of locations where hazardous materials are present.
   4. Hazardous materials will be removed by Owner under a separate contract.
   5. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
   6. There may be other hazardous materials beyond those identified in the report. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner in accordance with the General Conditions.

1.9 WARRANTIES

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

2.1 MATERIALS

A. General:
   1. Materials and workmanship shall conform to the requirements of other Sections of the Specifications.
   2. Where no materials are specified in these specifications, use materials of an equivalent type, quality, and size to match those existing in other areas of the facility.
   3. If none exist, use materials and workmanship recognized as of the highest quality in the industry.
   4. Obtain Engineer's review of such material and workmanship.

B. Piping: Existing piping which is removed from its present location shall not be reused where new piping is required unless specifically noted on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

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

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

D. Conflicts:
   1. 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.
   2. Promptly submit written report to Engineer.

E. Survey, or engage a competent person to survey condition of the building, in accordance with requirements of OSHA, to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during selective demolition operations.

F. Perform additional surveys as the work progresses to detect hazards resulting from operations to date.

3.2 UTILITY SERVICES

A. Maintain existing services indicated to remain and protect them against damage during selective demolition operations.

B. Interruptions:
   1. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and other authorities having jurisdiction.
   2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
   3. Provide at least 72 hours notice to Owner if shutdown of service is required during changeover.
   4. Exact timing of building system shut downs to be coordinated with the Owner, but assume those shut downs will occur between 12 a.m. and 5 a.m.

C. Utility Requirements:
   1. Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
   2. Owner will arrange to shut off indicated utilities when requested by Contractor.
   3. Arrange to shut off indicated utilities with utility companies.
   4. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition, provide temporary utilities that bypass areas of selective demolition and that maintain continuity of service to other parts of building.
   5. Cut off pipe or conduit in walls or partitions to be removed.
   6. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

A. Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.

B. Site Access and Temporary Controls:
   1. Conduct selective demolition and debris removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   2. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and other authorities having jurisdiction.
   3. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
   4. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
   5. Protect existing Site improvements, appurtenances, and landscape features to remain.
   6. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line or groups of trees to remain.

C. Temporary Facilities:
   1. Protection:
      a. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
      b. Provide protection to ensure safe passage of people around selective demolition area, and to and from occupied portion of building.
      c. Weather Protection:
         1) Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
         2) Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures.
         3) Coordinate enclosures with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
      d. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
      e. Cover and protect furniture, furnishings, and equipment that have not been removed.
   2. Shoring and Bracing:
      a. Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
      b. Strengthen or add new supports when required during progress of selected demolition.

3.4 POLLUTION CONTROLS

A. Dust Control:
   1. Use water mist, temporary closures, and other suitable methods to limit spread of dust and dirt.
   2. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
   3. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure.
   4. Vacuum carpeted areas.
   5. Comply with governing environmental protection regulations.

B. Disposal:
   1. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   2. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

3.5 GENERAL

A. Demolish and remove existing construction only to the extent required by new construction and as indicated.

B. Methods:
   1. Use methods required to complete the work within limitations of governing regulations.
   2. Cutting Openings:
      a. Neatly cut openings and holes plumb, square, and true to dimensions required.
      b. Use cutting methods least likely to damage construction to remain or to adjoining construction.
      c. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces.
      d. Temporarily cover openings to remain.
   3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   4. Flame Cutting:
      a. Do not use cutting torches until work area is cleared of flammable materials.
      b. At concealed spaces, such as duct and pipe chases, verify condition and contents of hidden space before starting flame-cutting operations.
      c. Maintain fire watch and portable fire suppression devices during flame-cutting operations.
      d. Maintain adequate ventilation when using cutting torches.
   5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials, and promptly and legally dispose of off Site.
   6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
   7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   8. Dispose of demolished items and materials promptly.
   9. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

C. Existing Facilities: Comply with Owner's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during the selective demolition operations.

D. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning and identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area as designated by Owner.
   5. Protect items from damage during transport and storage.

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

F. Existing Items to Remain:
   1. Protect construction indicated to remain against damage and soiling during selective demolition.
   2. When permitted by Engineer, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 DEMOLITION

A. Structures:
   1. Cut, repair, reuse, excavate, demolish or otherwise remove parts of the existing structures or appurtenances, as indicated on the Drawings, herein specified and necessary to permit completion of the Work.
   2. Dispose of demolished materials in an approved manner.
   3. Include necessary cutting, bending, and welding of reinforcing steel, structural steel, or miscellaneous metal work found embedded in the existing structures.
   4. When removing materials or portions of existing structures, shore up, underpin, and protect adjacent structures.
   5. Concrete:
      a. Demolish in small sections.
      b. Cut concrete to a depth of at least 3/4-inch at junctures with construction to remain, using a power driven saw.
      c. Dislodge concrete from reinforcement to remain at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated.
      d. Neatly trim openings to dimensions indicated.
   6. Engineer's review of cutting: No existing structure, equipment or appurtenance shall be shifted, cut, removed or otherwise altered without obtaining review of Engineer.

B. Equipment:
   1. Dismantle, remove, and relocate existing equipment, piping, and other appurtenances required for the completion of the Work.
   2. Cut existing pipelines for the purpose of making connections thereto.
   3. Cut off anchor bolts for equipment and structural steel indicated to be removed 1-inch below the concrete surface.
   4. Patch remaining concrete surface to smooth even finish.
   5. Remove air conditioning equipment without releasing refrigerants, if applicable.

C. Piping, Fire Protection, and Electrical Components:
   1. When a new connection is made to an existing pipeline, install additional new piping, extending to and including the most convenient new valve.
   2. Piping, conduit, and wiring indicated or required to be demolished shall be done so to the nearest reasonable connection outside of the Project area or as directed by Engineer.
   3. Where necessary or required for the purpose of making connections, cut existing pipelines in a manner to provide an approved joint.
   4. Weld beads, flanges, and provide Dresser couplings on existing and new piping.
   5. Remove and reinstall existing fire protection heads to allow for new construction.
   6. Comply with applicable fire protection codes.
   7. Furnish new heads, piping, and connections as required for completion of the Work.
   8. Remove junction boxes and electrical outlets which will no longer be in use.
   9. At existing walls which are made thicker, extend piping and wiring to accommodate additional wall thickness.
   10. Remove and reinstall fixtures and electrical outlets, switches, etc.

D. Ductwork:
   1. Remove portions of existing ductwork systems to the nearest branch outside the project area, except as indicated otherwise on drawings.
   2. Remove existing ductwork in a manner to minimize dispersion of dust in the duct system.
   3. Repair and replace existing insulation and duct liner disturbed by this Work to provide a continuous smooth surface.
   4. New connections to existing ductwork shall comply with the requirements of Division 23 Section “Metal Ducts.”

E. Masonry Walls:
   1. Where masonry walls are to be removed and replaced, and where filling existing openings, allow for toothing in of the new masonry at alternate courses so that the existing running bond pattern is maintained.
   2. Stone:
      a. Existing stone which becomes exposed due to the removal of materials such as adjacent walls, windows, doors, equipment, etc., shall be thoroughly cleaned, scraped, brushed, and tuck pointed to match adjacent existing stone.
      b. Blend appearance of exposed stone with the adjacent stone.
      c. Replace damaged stone with existing stone salvaged from demolition activities.
      d. Salvage all stone, including stone trim and cap shapes. Stack stone in crates, suitably protecting the stone from damage. Store crates where directed by Construction Manager.

F. Conceal Utilities: Recess new piping, conduit, and other utilities into floors, wires, and ceilings in finished areas.

G. Ownership of Salvaged Materials:
   1. Materials and equipment removed shall remain the property of Owner at Owner's option.
   2. Items not salvageable, as determined by Engineer and Owner, and items Owner elects not to keep shall become the property of Contractor to be properly disposed of off the Site.
   3. Salvaged equipment shall be thoroughly cleaned, lubricated, and greased for protection during prolonged storage.

H. Nonshrink Grout: Use nonshrink grout for setting wall castings, sleeves, leveling pump bases, doweling anchors into existing concrete and elsewhere as indicated.

I. Protect Facility from Water Damage: Provide flumes, hoses, piping, suitable plugs, bulkheads, or other means to divert or hold back the flow of wastewater, water, or other liquids, as required for proper performance of the Work.

J. Blasting: Not permitted.

K. Sleeves:
1. Subcontractors for mechanical, electrical, and other trades shall furnish sleeves and inserts for pipes, conduits, and similar items in forms, walls, partitions, and floors.
2. Perform work in cooperation with Contractor.
3. Place items in ample time so as not to delay operations.
4. Do not place sleeves so they pass through beams, girders, and similar construction.

L. Firestopping and Smokestopping: Install firestop and smokestop systems at utility penetrations in accordance with Division 07 Section “Penetration Firestopping.”

M. Miscellaneous: At existing walls which are made thicker, reinstall fire extinguisher cabinets, clocks, thermostats, and other wall hung items in new wall to accommodate additional wall thickness.

3.7 PATCHING AND REFINISHING

A. Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching:
1. Patch and repair existing surfaces from which items have been removed leaving holes, fasteners, and surface blemishes exposed to view.
2. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
3. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to Manufacturer’s written recommendations.
4. Comply with Division 01 for cutting and patching.

C. Refinishing:
1. Prepare existing surfaces for finishes by scraping, sanding, filling, acid etching, and sand blasting to ensure bonding and a smooth finish.
2. Refinish entire surfaces as necessary to provide an even finish.
3. Refinish continuous surfaces to the nearest intersection and entirely finish assemblies.
4. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
5. Refinish entire surfaces if necessary to remediate existing lead painted surfaces.

D. Floors and Walls:
1. Where floors or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space.
2. Provide an even surface of uniform finish, color, texture, and appearance.

3. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
4. Patch with durable seams that are as invisible as possible.
5. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
6. Where patching occurs in a painted surface, apply primer and intermediate coats over the patch and apply final coat over entire unbroken surface containing patch.
7. Provide additional coats until patch blends with adjacent surfaces.
8. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

E. Ceilings: Patch, repair, or rehang existing materials as necessary to provide even plane surface of uniform appearance.

3.8 CLEANING

A. Clean materials installed under this Section in accordance with Division 01.

B. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations.

C. Return adjacent areas to conditions existing before selective demolition operations began.

END OF SECTION 024119

SECTION 061000 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Miscellaneous framing and sheathing.

B. Concealed wood blocking, nailers, and supports.

1.2 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.

B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing 2003 (Reapproved 2017).

C. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. PS 1 - Structural Plywood 2019.

E. PS 20 - American Softwood Lumber Standard 2021.

1.3 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.3 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.

B. General Purpose Construction Adhesives: Comply with ASTM C557.
   1. Products:
      a. Franklin International, Inc; Titebond GREENchoice Subfloor Construction Adhesive: www.titebond.com/#sle.

2.4 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

B. Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber in contact with roofing, flashing, or waterproofing.
      c. Treat lumber in contact with masonry or concrete.
      d. Treat lumber less than 18 inches above grade.
      e. Treat lumber in other locations as indicated.
   2. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F.
      a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
      b. Treat plywood in contact with roofing, flashing, or waterproofing.
      c. Treat plywood in contact with masonry or concrete.
      d. Treat plywood less than 18 inches above grade.
      e. Treat plywood in other locations as indicated.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

D. Comply with fastener size and spacing indicated, but not less than required by applicable codes, AWC (WFCM) Wood Frame Construction Manual, and IBC Chapter 23 Wood Construction Spans and Fastener requirements.

3.3 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

C. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Wall-mounted door stops.
   6. Wall or Ceiling mounted Owner Furnished Equipment.

3.4 TOLERANCES

A. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.5 CLEANING

A. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

SECTION 062000 - FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finish carpentry items.

B. Hardware and attachment accessories.

1.2 REFERENCE STANDARDS

A. AWI (QCP) – Quality Certification Program; Current Edition.

1.3 SUBMITTALS

A. Product Data:
   1. Provide manufacturer's product data, storage and handling instructions for factory-fabricated units.

B. Samples: submit two samples of finished wood

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.
   2. Single Source Responsibility: Provide and install this work from single fabricator.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.

B. Protect from moisture damage.

C. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

2.2 SUSTAINABILITY CHARACTERISTICS

A. Provide sustainably harvested wood, certified or labeled to meet the USGBC LEED requirements.

B. Provide composite wood products complying with composite wood indoor emission to meet the USGBC LEED requirements.

2.3 LUMBER MATERIALS

A. Hardwood Lumber: white oak species, plain sawn, maximum moisture content of 6 percent ; with vertical grain , of quality suitable for transparent finish.

2.4 SHEET MATERIALS

A. High Density Particleboard: ANSI A208.1 Composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.

2.5 PANEL CORE MATERIALS

A. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.
   1. Grade: 115; moisture resistance: MR10.
   2. Panel Thickness: 3/4 inch.

2.6 PLASTIC LAMINATE MATERIALS

A. Plastic Laminate: NEMA LD 3; as indicated on drawings.

B. Low Pressure Laminate: Melamine; White color and matte surface texture.

C. Laminate Backing Sheet: NEMA LD 3, BKL; undecorated plastic laminate.

D. Laminate Adhesive: Type recommended by laminate manufacturer to suit application; not containing formaldehyde or other volatile organic compounds.

2.7 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

B. General: Furnish fastening materials of types appropriate for the conditions encountered, including wood to wood, wood to masonry or concrete and wood to metal. Use nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

C. Nails and Staples: Galvanized carbon steel, conforming to the requirements of ASTM F1667. Wood Screws: Galvanized carbon steel per ASME B 18.6.1.Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers. Expansion Anchors: Anchor bolt and sleeve assembly of carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5 with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing and inspecting agency. Adhesives: Aliphatic resin polyurethane, or resorcinol wood glue recommended for general carpentry use.

2.8 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Lumber for Shimming and Blocking: Hardwood lumber.

C. Wood Filler: Solvent base, tinted to match surface finish color.

2.9 WOOD TREATMENT

A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.

2.10 SITE FINISHING MATERIALS

A. Stain and Finishing Materials: In compliance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2.11 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

C. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

D. Apply laminate backing sheet to reverse face of plastic laminate finished surfaces.

E. Construction to comply with AWI QCP standards.

2.12 SHOP FINISHING

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5- Finishing for grade specified

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure materials and components in place, plumb and level.

C. General Millwork
1. Provide all wood blocking and framing required to support items of finish carpentry. Use fastening materials of types appropriate for the conditions encountered, including wood to wood, wood to masonry, and wood to metal stud framing. Counterbore holes for nuts and bolt heads, and countersink for screws. Use concealed fasteners in exposed surfaces of finish carpentry.
2. Before installing finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.
3. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements. Do not use manufactured units with defective surfaces, sizes, or patterns.
4. Furnish millwork in configurations shown and specified. AWI grading will take precedence over joiner details shown on Drawings. Provide tight joints. Miter exterior angles, cope interior angles and returns of trim moldings. Provide blind nailing where practicable. Secure work with finishing nails or screws and glue. Install trim in maximum practical lengths.
5. On surfaces exposed to view, set all nail heads and spackle. Countersink all screw heads and cover with neatly fitted wood plugs to match grain. Sand in accordance with AWI grading. Fit and scribe all work to walls or other finished work in a careful manner, so as not to injure the surface in any way.

D. Clean up
   1. Clean up and dispose of all waste material and refuse that has been brought onto the job or that has accumulated as a result of the work. Leave the work broom clean or better.
   2. Replace finish carpentry that is damaged or does not comply with requirements. Finish carpentry may be repaired or refinished if work complies with requirements and show no evidence of repair or refinishing. Adjust joinery for uniform appearance.
   3. Touch up any damaged finishes to restore to new matching adjacent areas.

END OF SECTION 062000

SECTION 064100 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops.

C. Hardware.

1.2 SUBMITTALS

A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

B. Product Data: Provide data for hardware accessories.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
   1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
   2. Single Source Responsibility: Provide and install this work from single fabricator.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.5 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.1 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Cabinets:
   1. Finish - Exposed Exterior Surfaces: High Pressure decorative laminate.
   2. Finish - Exposed Interior Surfaces: High Pressure decorative laminate.
   3. Finish - Semi-Exposed Surfaces: High Pressure decorative laminate.
   4. Finish - Concealed Surfaces: Manufacturer's option.
   5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
   6. Door and Drawer Front Retention Profiles: Fixed panel.
   7. Casework Construction Type: Type A - Frameless.
   8. Patterned Face Layout for Cabinet and Door Fronts: Flush panel.
      a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
   9. Cabinet Style: Flush overlay.
   10. Cabinet Doors and Drawer Fronts: Flush style.
   11. Drawer Side Construction: Manufacturer's option.

2.2 PANEL CORE MATERIALS

A. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.
   1. Grade: 115; moisture resistance: MR10.

2.3 THERMALLY FUSED LAMINATE PANELS

A. Thermally Fused Laminate (TFL): Melamine-resin-saturated decorative papers; for fusion to composite wood substrates under heat and pressure.
   1. Test in accordance with NEMA LD 3 Section 3.
   2. Panel Core Substrate: Medium Density Fiberboard (MDF).
   3. Color: White.

2.4 LAMINATE MATERIALS

A. Provide specific types as follows:
   1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, colors as indicated, finish as indicated.
   2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, colors as indicated, finish as indicated.
   3. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.5 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer's standard range.

C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

D. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color as selected by Architect from Manufacter's full range.

2.6 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.

C. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.

D. Drawer Slides:
1. Type: Full extension.
2. Static Load Capacity: Commercial grade.
3. Mounting: Side mounted.
4. Stops: Integral type.
5. Features: Provide self closing/stay closed and soft-closing type.

E. Hinges: Stainless steel, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips.

2.7 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.
1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
2. Cap exposed plastic laminate finish edges with plastic trim.

E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Seal cut edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use concealed joint fasteners to align and secure adjoining cabinet units.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinets to floor using appropriate angles and anchorages.

F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.3 ADJUSTING

A. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 064100

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.

1.3 SUBMITTALS

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

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
   1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For qualified Installer.

D. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

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

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.

2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
   a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
   b. Classification markings on penetration firestopping correspond to designations listed by the following:
      1) UL in its "Fire Resistance Directory."
      2) FM Global in its "Building Materials Approval Guide."

C. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grace Construction Products.
   2. Hilti, Inc.
   3. Johns Manville.
   4. Nelson Firestop Products.
   5. 3M Fire Protection Products.
   6. Tremco, Inc.; Tremco Fire Protection Systems Group.
   7. Specified Technologies Inc. (STI).

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls, and fire partitions.
   2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Horizontal assemblies include floors.
   2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated. See Drawings for 2 hour rated construction locations.
   3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall. See Drawings for 2 hour rated construction locations.

D. Penetrations in Smoke Resistive Walls: Provide penetration firestopping with ratings determined per UL 1479.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

E. Head-of-Wall: Provide water based acrylic spray firestopping system for head-of-wall for filling gaps between top of rated walls and metal floor/ roof decks. System to include manufacturer's standard accessory components required for fire test such as mineral wool filler within deck flutes, rated sealants, etc.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. 3M Fire Dam Spray 200 by 3M Fire Protection Products.
      b. CFS-SP-WB Firestop Joint Spray by HILTI.
      c. Type SA Acrylic Fire Stop Spray by USG.
      d. AS200 Elastomeric Firestop Spray by STI.
      e. TREMstop Acrylic SP by TREMCO Inc.

F. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

G. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

H. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

I. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-wool-fiber or rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Collars.
   5. Steel sleeves.

2.3 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

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

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.5 FIELD QUALITY CONTROL

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

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

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

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

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 MSU ISSUES

1. It the intent of MSU that all joint sealants used on its projects will comply with LEED™ NC 3 Credit Requirements EQ Credit 4.1: Low-Emitting Materials: Adhesives and Sealants.

1.2 SUMMARY

A. This Section includes joint sealants for the applications listed in 3.6 JOINT SEALANT SCHEDULE below, and including those specified by reference to this Section:

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. VOC Statement and Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

D. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

E. Qualification Data: For Installer and testing agency.

F. Preconstruction Field Test Reports: When requested by owner, indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

G. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

H. Field Test Report Log: For each elastomeric sealant application.

I. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

J. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

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

D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the commencement of the Work.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

E. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:

    a. Each type of elastomeric sealant and joint substrate indicated.
    b. Each type of nonelastomeric sealant and joint substrate indicated.

3. Notify M.S.U. Project Manager seven days in advance of dates and times when test joints will be erected.

    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.

        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

4. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Warranty

1. Provide installation warranty for a period of 5 years against defective materials and workmanship.

2. During the warranty period restore defective work to the standard of the contract documents without additional compensation, including all materials, labor, refinishing and other costs incidental to the work. Within 24 hours after receipt of notice from the owner, inspect the work and immediately repair leaks. Restore work found to be defective as defined in the contract documents, within 10 days after receipt of notice from the owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Single-Component Neutral-Curing Silicone Sealant; **SEALANT A**

1. Available Products:

   a. Dow; DOWSIL 790 Silicone Building Sealant.
   b. GE Silicones; SilPruf SCS2000.
   c. Dow; DOWSIL 791 Silicone Weatherproofing Sealant.
   d. Dow; DOWSIL 795 Silicone Building Sealant.
   e. Pecora Corporation; 895.
   f. Dow; DOWSIL 756 SMS Building Sealant.
   g. Or as approved

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

F. Multicomponent Immersible Urethane Sealant **SEALANT B**

1. Available Products:

   a. LymTal International, Inc., Iso-Flex 881 (NS – nonsag)
   b. LymTal International, Inc., Iso-Flex 880 (P – pourable).
   c. Or as approved

2. Type and Grade: M (multicomponent) and NS (nonsag) or P (pourable).
3. Class: 25.
4. Uses Related to Exposure: T (traffic), NT (nontraffic) and I (immersible).

G. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant **SEALANT C.**:

1. Available Products:

   a. Dow; DOWSIL 786 Silicone Sealant - M
   b. GE Silicones; Sanitary SCS1700.
   c. Tremco; Tremsil 200.
   d. Or as approved

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).

2.4 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834.**SEALANT D**.

B. Available Products:

1. DAP DYNAFLEX 230.
2. Pecora Corporation; AC-20+Silicone.
3. Or as approved.

2.5 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission**. SEALANT E**.

1. Available Products:

a. Pecora Corporation; BA-98.
b. Tremco; Tremco Acoustical Sealant.
c. Or as approved.

2.6 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) O (open-cell material) or B (bicellular material with a surface skin), as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

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

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates**,** where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

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

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. 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.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 CLEANING

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

3.5 PROTECTION

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

3.6 JOINT-SEALANT SCHEDULE

A. **SEALANT A**: Control joints in interior and exterior (non-traffic) masonry. Joints in interior and exterior precast architectural concrete. Joints between interior masonry non-bearing walls or partitions and under side of floors, beams and slabs. Joints around pipes, conduits, and ducts that penetrate walls and partitions. Exterior joints at perimeter of metal frames, including door and window frames. Exterior joints at ends of aluminum windowsills. Horizontal (non-traffic) and vertical expansion joints in exterior brick masonry.

B. **SEALANT B**: Isolation and control joints in exposed interior concrete floors. Expansion joints in interior tile. Expansion and control joints in exterior curbs and walks, and in paving other than concrete road paving, subject to pedestrian and vehicular traffic.

C. **SEALANT C**: Perimeter of toilet fixtures, vanities, kitchen counters, interior non-traffic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

D. **SEALANT D**: Interior joints at the perimeter of hollow metal doorframes (except at the face of hollow metal frames adjoining walls finished with wall tile, which will have grout tight to the door frames.)

E. **SEALANT E**: Use as specified in SECTION 095113 ACOUSTICAL PANEL CEILINGS.

END OF SECTION 079200

SECTION 081113 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 M.S.U. ISSUES

A. M.S.U. uses steel doors and frames for openings subject to repeated impact or abuse, or when appropriate to achieve required fire resistance rating

B. Steel framing is the M.S.U. standard for all interior doorways, paired with flush wood doors. (See Division 8 section 081416 FLUSH WOOD DOORS), and for interior windows.

C. When used on exterior openings, steel doors and frames shall be galvanized.

D. All public and personnel doors shall be a minimum of 36” wide to provide barrier free access for mobility aid users.

E. All public and personnel doorway thresholds shall meet the latest ICC/ANSI A117.1 standards to provide barrier free access for mobility and physically impaired users.

1.2 SUMMARY

A. This Section includes the following:

1. Standard hollow-metal steel frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire resistance rating and finishes for each type of steel door and frame specified.

B. Oversize Construction Certification: For standard steel door assemblies required to be fire rated and exceeding limitations of labeled assemblies; include statement that doors comply with requirements of design, materials, and construction but have not been subjected to fire test.

C. Qualification Data: For Installer.

D. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

D. Fire-Rated Door 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 COORDINATION

A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Amweld Building Products, LLC.
2. Ceco Door Products; an ASSA ABLOY Group Company.
3. CURRIES Company; an ASSA ABLOY Group Company.
4. Fleming Door Products Ltd.; an ASSA ABLOY Group Company.
5. Pioneer Industries, Inc.
6. Republic Doors and Frames; a Windsor Republic Door Company
7. Steelcraft; an Ingersoll-Rand Company.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy (galvannealed) coating designation.

D. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching standard steel door frames of type indicated.

G. Grout: Comply with ASTM C 476, with a slump of 4 inches for standard steel door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.

H. Glazing: Comply with requirements in Division 8 Section "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.

1. Fabricate frames with mitered or coped and welded face corners.
2. Frames for Level 2 Steel Doors and for flush wood doors 0.053-inch- thick steel sheet.
3. Frames for Level 3 Steel Doors: 0.067-inch-thick steel sheet.

C. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:

1. Hinges: Minimum 0.123 inches thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
2. Lock Face Closers, and Concealed Holders: Minimum 0.067 inch thick.
3. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.

D. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.

E. 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. 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.

F. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

G. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch high, unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.5 FABRICATION

A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
3. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete, masonry or plastered walls.
4. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. 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 in height.
        2) Four anchors per jamb from 60 to 90 inches in height.
        3) Five anchors per jamb from 90 to 96 inches in height.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
        5) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.

    b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section DOOR HARDWARE.

1. Reinforce doors and frames to receive non-templated mortised and surface-mounted door hardware.
2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

D. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of doors and frames.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.6 STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish standard steel door and frames after assembly.

B. Metallic-Coated Steel Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of standard steel doors and frames.

1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

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

3.3 INSTALLATION

A. General: Provide frames of sizes, thicknesses, and designs indicated. Install standard steel frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Standard Steel Frames: Install standard steel frames for doors and other openings, of size and profile indicated. Comply with SDI 105.

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 due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable glazing stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Apply bituminous coating to backs of all exterior frames and those that are filled with mortar, grout, and plaster containing anti freezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
4. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

D. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 M.S.U. ISSUES

A. Transparent finished wood doors and steel frames are the standard interior doors at M.S.U.

B. All public and personnel doors shall be a minimum of 36” wide to provide barrier-free access for mobility aid users.

C. It the intent of MSU that all flush wood doors used on its projects will comply with LEED™ NC 3 Credit Requirements MR Credit 4: Recycled Content, 10% (post-consumer + ½ pre-consumer), MR Credit 4: Recycled Content 20% (post-consumer + ½ pre-consumer), and EQ Credit 4.2 Low-Emitting Materials: Paints and Coatings. EQ Credit 4.2 will apply only in the instance of field finished doors.

1.2 SUMMARY

A. This Section includes the following:

1. Solid-core doors with plastic laminate faces.

1.3 SUBMITTALS

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

B. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:

1. Faces of Factory-Finished Doors: Show the full range of colors available for stained finishes.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edgings representing typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.
3. Frames for light openings, 6 inches long, for each material, type, and finish required.

D. Submit printed statement and product data for field applied finishes in accordance with the General Administrative Requirements of the MSU Construction Standards 01300.1.2. Maximum VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1113, Architectural Coatings:
   1. Clear Wood Finishes: Varnish Maximum 350 g/l, Lacquer Maximum 550 g/l
   2. Stains: Maximum 250 g/l
   3. Sealers: Waterproofing 250 g/l
   4. Sanding Sealers 275 g/l
   5. All Other Sealers 200 g/l

E. Quality Assurance: Provide documentation as described in this section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

   1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.

1.5 DELIVERY, STORAGE, AND HANDLING

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

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with Project Number and opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Flush Wood Doors:

a. Algoma Hardwoods Inc.
b. Eggers Industries; Architectural Door Division.
c. GRAHAM Manufacturing Corp.
d. Marshfield DoorSystems.
e. Mohawk Flush Doors, Inc.
f. Oshkosh Architectural Door Co.
g. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

A. Doors for Transparent Finish:

1. Grade: Premium, with Grade AA faces.

2.3 SOLID-CORE DOORS

A. Interior Veneer-Faced Doors:

1. Core: Glued block or structural composite lumber.
2. Construction: Five or seven plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

2.4 FABRICATION

A. Fabricate doors in sizes indicated for Project-site fitting.

B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:

1. Comply with clearance requirements of referenced quality standard for fitting.

C. Factory machine doors for hardware that is not surface applied.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2.5 FACTORY FINISHING

A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.

B. Transparent Finish:

1. Grade: Premium.
2. Finish: AWI System TR-4 Conversion Varnish.
3. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."

B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083100 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall-mounted access units.

1.2 SUBMITTALS

A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

PART 2 PRODUCTS

2.1 WALL- MOUNTED ACCESS UNITS

A. Wall-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
   1. Material: Steel, hot-dipped zinc or zinc-aluminum-alloy coated.
      a. Provide aluminum units in mechanical rooms and similar spaces.
   2. Style: Exposed frame with door surface flush with frame surface.
      a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
   3. Door Style: Single thickness with rolled or turned in edges.
      a. Provide double-skin insulated units at exterior walls and acoustically rated walls.
   4. Frames: 16-gauge, 0.0598-inch minimum thickness.
   5. Single Steel Sheet Door Panels: 16-gauge, 0,0625-inch minimum thickness.
   6. Double-Skinned Hollow Steel Sheet Door Panels: 16-gauge, 0.059-inch minimum thickness, on both sides and along each edge.
   7. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
      a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
      b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
   8. Steel Finish: Primed.
   9. Stainless Steel Finish: No.4 brushed finish.
   10. Aluminum Finish: Natural brushed.
   11. Door/Panel Size: as indicated on the drawings or 12" x 12" if not indicated.
   12. Hardware:
      a. Hardware for Fire-Rated Units: As required for listing.
      b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
      c. Handle: No handle.
      d. Latch/Lock: Screw driver slot for quarter turn cam latch.
      e. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.

f. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.
g. Gasketing for Double-skined Panels: Extruded neoprene, around perimeter of door panel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 083100

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 M.S.U. ISSUES

A. On interior doors, do not install lights that extend below the level of the top of the mounting of the exit device or the lockset.

B. At the end of a project, all unused door hardware should be provided to the M.S.U. Key Shop.

C. When appropriate, wall magnet door holders should be provided to hold doors open during heavy usage periods to save unnecessary wear on the mechanism.

D. Hinges on all doors that open outward (reverse bevel) shall have NRP (Non Removable Pin) hinges.

E. A door closer is required on all doors in new or renovated computer labs (or similar spaces) which are not served by building central air conditioning and have window or room air conditioning equipment if the doors connect to non-air conditioned spaces.

F. All public and personnel doorway hardware shall meet the latest A.D.A. - ICC/ANSI A117.1 standards to provide barrier free access for mobility and physically impaired users.

G. Where card access controls are provided, electrified locksets or electrified panic bars shall be used instead of electric strikes. The electrified hardware shall include an RX (Request to Exit) switch.

1.2 SUMMARY

A. Section includes:
   1. Mechanical and electrified door hardware for:
      a. Swinging doors.
      b. Other doors to the extent indicated.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:
   1. Windows
   2. Cabinets (casework), including locks in cabinets
   3. Signage
   4. Toilet accessories
   5. Overhead doors

C. The following list is provided as a reference to clearly identify manufacturers cited in this standard:

1.	Arrow	Arrow Architectural Hardware; an ASSA ABLOY Group company
2.	Baldwin	Baldwin Hardware Corporation
3.	Best	Best Access Systems, Division of The Stanley Works
4.	Corbin Russwin	Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company
5.	Glynn-Johnson	Glynn-Johnson; an Ingersoll-Rand Company
6.	Hager	Hager Companies
7.	Ives	Ives; an Ingersoll-Rand Company
8.	LCN	LCN Closers; an Ingersoll-Rand Company
9.	McKinney	McKinney Products Company; an ASSA ABLOY Group company
10.	Pemko	Pemko Manufacturing Company, Inc.; an ASSA ABLOY Group company
11.	Reese	Reese Enterprises, Inc.
12.	Rockwood	Rockwood Manufacturing Company; an ASSA ABLOY Group company
13.	Sargent	Sargent Manufacturing Company; an ASSA ABLOY Group company
14.	National Guard	National Guard Products, Inc.
15.	Von Duprin	Von Duprin; an Ingersoll-Rand Company

1.3 REFERENCES

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

B. DHI - Door and Hardware Institute
   1. Sequence and Format for the Hardware Schedule
   2. Recommended Locations for Builders Hardware
   3. Key Systems and Nomenclature

C. ANSI - American National Standards Institute
   1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.4 SUBMITTALS

A. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
   a. Organize door hardware sets in same order as in the Door Hardware Schedule at the end of Part 3.
3. Content: Include the following information:
   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following:
   1. Michigan Department of Labor, Bureau of Construction Codes and Fire Safety.
   2. Michigan State Police Fire Marshal Division.
      a. Hardware furnished for labeled openings shall be labeled and have been tested by a testing laboratory recognized by the Michigan State Police Fire Marshal Division.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Each item of hardware shall be individually wrapped and packaged to avoid scratching or marking of the finishes.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule and include basic installation instructions with each item or package.

1.7 COORDINATION

A. Coordinate layout and installation of recessed pivots and closers with floor construction. Anchoring inserts shall be cast into concrete.

B. Templates: Obtain and distribute to the parties involved 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.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
      a. Locksets:
         1) Mechanical: 3 years.
      b. Key Blanks: Lifetime
   2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 MAINTENANCE

A. Maintenance Tools:
   1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and particular project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”
   1. Where “No Substitute” is noted, submittals and substitution requests for other products will not be considered.

B. Approval of manufacturers and/or products other than those listed as ”Scheduled Manufacturer ” or “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

C. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

A. Fasteners
   1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
   2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
   3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
   4. Install hardware with fasteners provided by hardware manufacturer.

2.3 HINGES

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Hager BB series
   2. Acceptable Manufacturers and Products: McKinney TA/T4A series or approved equal.

B. Requirements:
   1. Provide five-knuckle, ball bearing hinges conforming to ANSI/BHMA A156.1.
   2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
      a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
      b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
   3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
      a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
      b. Interior: Heavy weight, steel, 5 inches (127 mm) high
   4. 2 inches or thicker doors:
      a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
      b. Interior: Heavy weight, steel, 5 inches (127 mm) high
   5. Hinge locations shall conform to the National Builders Hardware Association Standards. M.S.U. avoids pivot hinges because they collect dirt and salt.
   6. On relatively new installations and when existing conditions warrant, salvage existing hinges, clean, lubricate, and reinstall.
   7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
      a. Steel Hinges: Steel pins
      b. Non-Ferrous Hinges: Stainless steel pins
      c. Out-Swinging Exterior Doors: Non-removable pins
      d. Out-Swinging Interior Lockable Doors: Non-removable pins
      e. Interior Non-lockable Doors: Non-rising pins
   8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

9. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
10. Electric hinges shall not be permitted.

2.4 MORTISE LOCKS

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Corbin Russwin ML2000 series
   2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:
   1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
   2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
   3. The lock set must accept Best interchangeable 7-pin tumbler cores and cylinders.
   4. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
   5. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
   6. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
      a. Lever Design: NSN.
      b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.5 CYLINDERS AND KEYING

A. Manufacturers:
   1. Scheduled Manufacturer: Best.
   2. Acceptable Manufacturers: No Substitute.

B. Requirements:
   1. All locking devices shall be supplied prepared for seven pin cylinders manufactured by Best Lock Corporation.
   2. All existing cylinders and cores will be salvaged to the M.S.U. Key Shop, unless otherwise directed.
   3. All cylinders, cores, and keys, temporary and permanent, shall be furnished by the M.S.U. Key Shop, which shall also perform the following:
      1) Remove existing cores and install construction cores on ***existing doors*** as required.

2) Furnish construction cylinders, cores, and keys for ***new doors***.
   a) The contractor shall supply the M.S.U. Project Representative with a copy of the project Hardware Schedule to allow the Key Shop to match cylinders to the new hardware.
   b) The contractor shall pick up cylinders, cores, and keys from the M.S.U. Key shop with the form "Authorization for Construction Cylinders, Cores, and Keys", completed and authorized by the M.S.U. Project Representative.
   c) The contractor shall install construction cylinders in new doors for alignment of hardware, for use during construction, and for inspection of operation.
   d) All construction keys issued to a contractor for a particular project will be returned to the Key Shop before final payment will be granted. Lost keys are subject to fines consisting of the cost of re-keying all locks on campus, which have the same code as the lost key.
   e) The contractor shall tag and supply to the M.S.U. Key shop one copy of the key for each non-standard lock installed.

2.6 PROTECTION PLATES

A. Manufacturers:
   1. Scheduled Manufacturer: Rockwood.
   2. Acceptable Manufacturers: No Substitute.

B. Requirements:
   1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
   2. Kick plates are required on the push side of all doors that have door closers. Kick plates shall be beveled on three sides and furnished with match oval head screws.
   3. Rockwood 304 stainless steel kick plate -.050 inch x 16" high x width of door less 1 inch. Provide higher or lower protection when noted on door schedule.

2.7 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:
   1. Scheduled Manufacturers: Glynn-Johnson.
   2. Acceptable Manufacturers: No Substitute.

B. Requirements:
   1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
   2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
   3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.

4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.8 DOOR STOPS AND HOLDERS

A. Manufacturers:
   1. Scheduled Manufacturer: Ives.
   2. Acceptable Manufacturers: Baldwin.

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

2.9 FINISHES

A. Finish: Provide as specified.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.2 PREPARATION

A. Where on-site modification of doors and frames is required:
   1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
   2. Field modify and prepare existing door and frame for new hardware being installed.
   3. When modifications are exposed to view, use concealed fasteners, when possible.

4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
   a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
   b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
   c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
   1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
   2. Custom Steel Doors and Frames: HMMA 831.
   3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Lubricate and adjust all hardware to operate properly.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Replace construction cores with permanent cores as indicated in keying section.

J. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
   1. Conduit, junction boxes and wire pulls.
   2. Connections to and from power supplies to electrified hardware.
   3. Connections to fire/smoke alarm system and smoke evacuation system.

4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

M. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
1. Configuration: Provide one power supply for each door opening with electrified door hardware.

O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

S. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

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

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.8 DOOR HARDWARE SCHEDULE

A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

HARDWARE GROUP NO. 01

FOR USE ON DOOR #(S):
B120D

PROVIDE EACH OPENING WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	BB1279	652	HAG
1	EA	CLASSROOM LOCK	ML2055 NSN LC	626	C-R
1	EA	MORTISE CYLINDER	BY OWNER	626	BES
1	EA	OH STOP	100S	630	GLY
1	EA	KICK PLATE	304 16" X 2" LDW	630	ROC

HARDWARE GROUP NO. 02

FOR USE ON DOOR #(S):
B107A B108D B120C

PROVIDE EACH OPENING WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	BB1279	652	HAG
1	EA	CLASSROOM LOCK	ML2055 NSN LC	626	C-R
1	EA	MORTISE CYLINDER	BY OWNER	626	BES
1	EA	KICK PLATE	304 16" X 2" LDW	630	ROC
1	EA	WALL STOP	WS33(X)	626	IVE

HARDWARE GROUP NO. 03

FOR USE ON DOOR #(S):
B107 B108A B120-1 B120-2 B123-1 B123-2
B123A B123B

PROVIDE EACH OPENING WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CLASSROOM LOCK	ML2055 NSN LC	626	C-R
1	EA	KICK PLATE	304 16" X 2" LDW	630	ROC

BALANCE OF EXISTING HARDWARE TO REMAIN. REUSE EXISTING CYLINDER AND INSTALL IN NEW LOCKSET.

HARDWARE GROUP NO. 04

FOR USE ON DOOR #(S):
B120A B120B

PROVIDE EACH OPENING WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	OFFICE LOCK	ML2051 NSN LC	626	C-R
1	EA	KICK PLATE	304 16" X 2" LDW	630	ROC

BALANCE OF EXISTING HARDWARE TO REMAIN. REUSE EXISTING CYLINDER AND INSTALL IN NEW LOCKSET.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Observation Windows.
2. Doors.

1.2 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

a. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.

1) For monolithic-glass lites heat-treated to resist wind loads.
2) For insulating glass.
3) For laminated-glass lites.

B. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1.4 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 12-inch- square Samples for glass and of 12-inch- long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

C. Samples: For the following products, in the form of 12-inch- square Samples for glass.

1. Each color of tinted float glass.

D. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

F. Qualification Data: For installers.

G. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

H. Product Test Reports: For each of the following types of glazing products:

1. Tinted float glass.

I. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance.

B. Source Limitations for Glass: Obtain insulating glass through one source from a single manufacturer for each glass type:

C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.

1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

E. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201, and, for wired glass, ANSI Z97.1.

F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.
2. Associated Laboratories, Inc.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

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

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.8 WARRANTY

A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

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

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

2.2 GLASS PRODUCTS

A. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

B. Transparent One-Way Mirror: Mirror quality float glass with pyrolytic (hard coat) type coating located on high light level surface of glass; ASTM C1376.

1. Applications: Observation windows in SIM Observation rooms.
2. Thickness: ¼ inch.
3. Glass Tint: Grey.
4. Glass Type: Fully tempered.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:

1. Neoprene, ASTM C 864.
2. EPDM, ASTM C 864.
3. Silicone, ASTM C 1115.
4. Thermoplastic polyolefin rubber, ASTM C 1115.

2.4 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select 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.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

2.5 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.6 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

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

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

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 sealant-substrate 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 30 inches as follows:

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

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

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 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, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended 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.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 092116 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Interior gypsum board.

B. Trim and drywall finishing.

C. Non-loadbearing metal framing

1.3 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.

D. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2009).

E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.

F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.

G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.

H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.

I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.

J. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

K. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.

L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.

M. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.

N. ASTM E413 - Classification for Rating Sound Insulation; 2010.

O. GA-216 - Application and Finishing of Gypsum Board; 2013.

P. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2008.

Q. GA-600 - Fire Resistance Design Manual; 2015.

R. ICC (IBC) - International Building Code; 2015.

S. UL (FRD) - Fire Resistance Directory; current edition.

1.4 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

2.2 METAL FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; sheet steel with G60/Z180 hot dipped galvanized coating, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
   1. Studs: "C" shaped with flat or formed webs with knurled faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

B. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required with G60/Z180 hot dipped galvanized coating.

C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.

2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. CertainTeed Corporation; www.certainteed.com.
   2. National Gypsum Company; www.nationalgypsum.com.
   3. USG Corporation; www.usg.com.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Adhere on both sides of existing metal partition systems.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold resistant board is required in toilet rooms, custodial rooms, and mechanical rooms.
   3. Thickness:
      a. Vertical Surfaces: 1/4 inch.

C. Fiber Reinforced Interior Gypsum Board ASTM C1278: Standard Classification for Fiber Reinforced Interior Gypsum Panel Products.
   1. Application: Use for vertical surfaces of new walls, unless otherwise indicated.
   2. Basis of Design: Subject to compliance with project requirements, the design is based on the following: “USG Corporation, Fiberock® Brand Abuse Resistant Panels Regular and type X Panels”.
      a. Abrasion Resistance; Level 1.
      b. Indentation Resistance; Level 1.
      c. Soft Body Impact Resistance; Level 2.
      d. Hard Body Impact Resistance; Level 1.
   3. UL Type Designation “FRX-G”.
   4. ASTM E84 Surface-Burning Characteristics:
      a. Flame Spread: 5.
      b. Smoke Developed: 0.
   5. Thickness: 5/8 inch.
   6. Provide water resistant gypsum panels within 6’-0” in any direction of plumbing fixture, at painted walls.

2.4 ACCESSORIES

A. Flexible Glass Fiber Blanket Acoustic Insulation: Preformed insulation, complying with ASTM C665; friction fit.
   1. Available Manufacturers:
      a. CertainTeed Corporation.
      b. Guardian Fiberglass, Inc.
      c. Johns Manville.
      d. Knauf Fiber Glass.
      e. Owens Corning.

2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
4. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
5. Formaldehyde Content: Zero.
6. Thickness: As indicated on the drawings. inch.
7. Facing: Unfaced.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
   1. Products:
      a. Franklin International, Inc.; Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant: www.titebond.com/sle.
      b. Substitutions: See Division 01.

C. Acoustical Putty Pads: located stud side of device box within 24 inches of each other and at junction boxes.
   1. Manufacturers:
      a. ATS Acoustical Putty Pads.
      b. SpecSeal SSP Putty Pads.
      c. SoundProofing Company Putty Pads.

D. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
   1. Rigid Corner Beads: Low profile, for 90 degree outside corners and archways.
   2. Expansion Joints: V-shaped PVC with tear away fins.

E. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
   1. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
   2. Tape: 2 inch wide, coated glass fiber tape for joints and corners.
   3. Ready-mixed vinyl-based joint compound.
   4. Chemical hardening type compound.

F. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

I. Adhesive for Attachment to Metal:
   1. Products:
      a. Franklin International, Inc.; Titebond PROvantage Professional Drywall Adhesive: www.titebond.com/sle.
      b. Substitutions: See Division 01.

J. Rigid Connector for Partial Height Wall:
   1. Products:
      a. Simpson Strong-Tie, RCKW Kneewall Connectors: https://www.strongtie.com/rigidconnectors_coldformedsteelconstruction/rckw_connect/p/rckw
      b. Model: RCKW3
      c. Substitutions: See Division 01
K. Stiffener for Partial Height Wall:
   1. Products:
      a. Simpson Strong-Tie, RCKW Kneewall Connectors: https://www.strongtie.com/rigidconnectors_coldformedsteelconstruction/rckw_connect/p/rckw
      b. Model: RCKW3S
      c. Substitutions: See Division 01

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 GENERAL REQUIREMENTS

A. Coordinate with any special requirements for substrate for Gypsum Plaster Veneer.

3.3 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure unless noted otherwise.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

D. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
   1. Orientation: Horizontal.
   2. Spacing: As indicated.

3.4 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.5 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Non-Rated: Install gypsum board perpendicular to framing, with ends and edges occurring over firm bearing.
   1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

3.6 INSTALLATION OF TRIM AND ACCESSORIES

A. Corner Beads: Install at external corners, using longest practical lengths.

B. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.7 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 3: Utility spaces.
   3. Level 2: Behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
   5. Level 0: Temporary partitions.

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
   3. Taping, filling and sanding is not required at base layer of double layer applications.

D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.8 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 092116

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 M.S.U. ISSUES

1. It the intent of MSU that all joint sealants used on its projects will comply with LEED™ NC 3 Credit Requirements EQ Credit 4.1: Low-Emitting Materials: Adhesives and Sealants.
2. If a project involves removal of ceiling panels in sufficient quantity for recycling under the programs by USG and Armstrong, tiles will be stacked on pallets and stored in a dry location until they are picked up for recycling by a panel manufacturer.

1.2 SUMMARY

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

B. Related Sections include the following:

1. Division 07 Section JOINT SEALANTS.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated and including VOC Statements for Sealants and Adhesives.

B. Maintenance Data: For finishes to include in maintenance manuals.

C. Certificate of Accreditation: Provide certificate as described in this section.

D. Scope of Accreditation: Provide scope as described in this section.

1.4 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Surface-Burning Characteristics: Provide acoustical panels with surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

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

2.2 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 CAST OR MOLDED, MINERAL-BASE ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. Available Manufacturers:

1. Armstrong World Industries, Inc.
2. BPB Celotex Corporation; Architectural Ceilings Marketing Dept.
3. National Gypsum
4. USG Interiors. Inc.

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

1. Type and Form: Type III, mineral base with painted finish; Form 4, cast or molded.

C. Color: White

D. Edge Detail: Reveal sized to fit flange of exposed suspension system member.

E. Thickness: ¾ inch.

F. Size: 24 by 24 inches.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.

E. Joint Sealants: See 07 Section JOINT SEALANTS.

2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING:

A. Available Manufacturers:

1. Armstrong World Industries, Inc.
2. BPB Celotex Corporation; Architectural Ceilings Marketing Dept.
3. Chicago metallic Corporation
4. USG Interiors, Inc.

B. Wide-Face, Capped, Double-Web, 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: Butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel cold-rolled sheet.
5. Cap Finish: Painted white .

2.6 METAL EDGE MOLDINGS AND TRIM

A. Available Manufacturers:

1. Armstrong World Industries, Inc.
2. BPB Celotex Corporation; Architectural Ceilings Marketing Dept.
3. Chicago Metallic Corporation.
4. Fry Reglet Corporation.
5. Gordon, Inc.
6. MM Systems, Inc.
7. USG Interiors, Inc.

B. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, GENERAL

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. Do not attach hangers to steel deck tabs.
7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:
   a. Install panels with pattern running in one direction parallel to long axis of space.
2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096500 - RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient sheet flooring.

B. Installation accessories.

1.2 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

B. Shop Drawings: Indicate seaming plans and floor patterns.

C. Verification Samples: Submit two samples, 6 by 9 inch in size illustrating color and pattern for each resilient flooring product specified.

D. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum ten years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum five years documented experience.
   1. Experience on at least three projects of similar size, type and complexity as this project.
   2. Employer of workers for this project who are competent in techniques required by manufacturer for resilient flooring installation indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F and 85 degrees F.

D. Protect roll materials from damage by storing on end.

1.5 FIELD CONDITIONS

A. Product Installation:
   1. Maintain temperatures during installation within range recommended by manufacturer, but not less than 65 deg F and 85 deg F in spaces to receive flooring one week before installation, during installation, and maintain thereafter installation.
   2. After installation, maintain temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 85 deg F.
   3. Prohibit traffic during flooring installation.
   4. Refer to the adhesive technical data sheet for appropriate time fore foot traffic after installation.

B. Install flooring only after all other trades, including painting and overhead work, has been completed.

1.6 WARRANTY

A. Manufacturer warrants that flooring products are free from manufacturing defects. Refer to product-specific warranty document for additional detail and warranty period.
   1. Material warranty must be direct from the product manufacturer.
   2. Material warranties from separate or third-party insurance providers are not valid.
   3. Material warranties from private label distributors are not valid.
   4. Failures include material manufacturing defects.
   5. Warranty period for materials is 10 years from date of Substantial Completion.

1.7 ENVIRONMENT AND INDOOR AIR QUALITY

A. LEED Documentation:
   1. LEED v4 MR Credit, Building Product Disclosure & Optimization, Sourcing of Raw Materials: For products having recycled content, indicate percentage by weight of post-consumer and pre-consumer recycled content.
   2. LEED v4 MR Credit, Building Product Disclosure & Optimization, Environmental Product Declaration: For products having an industry wide EPD.
   3. LEED v4 EQ Credits: For adhesives and flooring, including a statement of VOC content, FloorScore® certified.

B. Indoor Air Quality Certification: Flooring products must be FloorScore Certified.

PART 2 PRODUCTS

2.1 SHEET FLOORING

A. Vinyl Sheet Flooring: Transparent or translucent vinyl wear layer over interlayer and backing.
   1. Manufacturers: As indicated on Drawings.
   2. Wear Layer Thickness: 0.020 inch minimum.

3. Total Thickness: 0.080 inch minimum.
4. Seams: Heat welded.
5. Color: As indicated on drawings.

B. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

2.2 ACCESSORIES

A. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

B. Transitions: Install cove cap on top of base. Match color to cap used in existing building.
1. Manufacturers: Tarkett.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Other work, including overhead work, that could cause damage, dirt, dust or otherwise interrupt installation has been completed or suspended.

D. No foreign materials or objects are present on the substrate and that it is clean, porous and ready for preparation and installation.

3.2 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

D. Clean substrate immediately before installation. After cleaning, examine substrate for moisture, alkaline salts, grit, dust or other contamination. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Resilient Strips: Attach to substrate using adhesive.

E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

F. Install flooring in recessed floor access covers, maintaining floor pattern.

3.4 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

B. Seal seams by heat welding where indicated.

C. Adhered Flooring to substrates using a full-surface or full-spread application of adhesive to the substrate to comply with adhesive and flooring manufacturer instructions.

3.5 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.6 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. Protect flooring from abrasions, indentations, and other damage from subsequent operations and placement of equipment, during remainder of construction period.

END OF SECTION 096500

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 M.S.U. ISSUES

A. Heavy marbleized or terrazzo type patterns are preferred. Extremely light or dark colors should not be selected.

B. The factory applied finish on the tile shall be removed using a floor-scrubbing machine and the stripper prepared by the manufacturer of the wax to be applied; and a new finish applied. The M.S.U. Project Manager will contact Housing and Food Services or Physical Plant Custodial Services to identify the current finish being used by M.S.U.

C. It is the intent of MSU that all resilient floor tile installation used on its projects will comply with LEED™ NC 2.2 Credit Requirements EQ Credit 4.1: Low Emitting Materials: Adhesives and Sealants

D. It is the intent of MSU that all resilient tile flooring materials and methods of installation shall meet the latest ICC/ANSI A117.1 standards for slip resistance and provide barrier free access for mobility and physically impaired users.

1.2 SUMMARY

A. This Section includes the following:

1. Resilient Tile Flooring.
2. Resilient wall base and accessories.

1.3 SUBMITTALS

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

B. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.

1. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples of each resilient product color and pattern required.

C. Maintenance Data: For resilient products to include in maintenance manuals.

D. Submit printed VOC statement and product data for adhesives in accordance with the General Administrative Requirements of the MSU Construction Standards 01300.1.2. Maximum VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, effective July 1, 2005 and amended January 7, 2005:

1. Cove Base Adhesives 50 g/l
2. Rubber Floor Adhesives 60 g/l

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store tiles on flat surfaces.

B. Check materials for damage and the correct style, color, quantity and run numbers.

1.6 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor covering installation.

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

E. Install resilient products after other finishing operations, including painting, have been completed.

1.7 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. Floor Tile: Furnish 2 boxes of each type, color, and pattern of floor tile installed.
2. Resilient Wall Base and Accessories: Furnish not less than 20 linear feet of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 TILE FLOORING

A. Luxury Vinyl Tile: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
1. Manufacturers: As indicated on drawings. Substitutions not permitted.
2. Size: As indicated on drawings.
3. Color: As indicated on drawings.

2.2 RESILIENT WALL BASE

A. Wall Base: ASTM F 1861.

B. Available Manufacturers: As indicated on drawings.

C. Type (Material Requirement): TV (vinyl).

D. Group (Manufacturing Method): I (solid, homogenous).

E. Style: Cove (with top-set toe) for installation on resilient flooring. Straight (toeless) for installation on carpeted flooring.

F. Minimum Thickness: 0.125 inch.

G. Height: 4 inches.

H. Lengths: Coils in manufacturer's standard length.

I. Outside Corners: Job formed.

J. Inside Corners: Job formed.

K. Surface: Smooth.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
3. Moisture Testing:

    a. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. 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.

D. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

E. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

F. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

1. Do not install resilient products until they are same temperature as space where they are to be installed.

G. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.5 RESILIENT ACCESSORY INSTALLATION

A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.6 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

    a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
1. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 096519

SECTION 096800 – CARPETING

PART 1 - GENERAL

1.1 M.S.U. ISSUES

A. Broadloom and/or carpet tile may be used depending on existing conditions and design intent in residential, dining, lounge and administrative spaces of Housing and Food Services buildings. In Academic buildings, the typical areas for carpet are administrative, auditoriums, libraries, conference rooms, large lecture halls, reception rooms and lounges. Classroom carpeting is not recommended. Carpeting is not recommended for any ground floor public lobby, due to high maintenance required for winter slush and salt, and will be permitted in those locations only with the approval of both IPF Planning, Design and Construction, and IPF Building Services. Carpet shall meet flame, smoke and other code mandated fire safety standards.

B. Direct glue down installation is preferred. The use of carpet cushion in corridors, classrooms, lobbies and places of public assembly is discouraged

C. Computer room carpeting shall be especially constructed for use in computer rooms with permanent anti-static properties at a level acceptable to the computer manufacturer (typically 2.0 or less.)

D. When base is specified in conjunction with the carpet, it shall be square-cut straight 4-inch vinyl base, installed prior to the installation of the carpet. It shall be glued to the walls and base cabinets, with field formed corner pieces jointed at least two-feet beyond the corner. Color shall be dark brown or black consistent with the building standard.

E. Carpet without cushion shall be glued to the substrate. Carpet with cushion shall have cushion glued directly to the substrate. Carpet over cushion shall be installed using the double stick method.

F. All scraps of carpet larger than ten square feet shall be delivered to the Project Representative to be stored at the building for future repairs.

G. It is the intent of MSU that all carpet and carpet tile installation used on its projects will comply with LEED™ NC 2.2 Credit Requirements EQ Credit 4.1: Adhesives and Sealants and LEED NC 2.2 Credit Requirements EQ Credit 4.3: Low-Emitting Materials Carpets for carpets and installation accessories.

1.2 SUMMARY

A. This Section includes the following:

1. Carpet Tile

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate required.

B. Provide an installation diagram from the carpet installer prior to installation. It will include the following as applicable to the project:

1. Columns, doorways, enclose walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Seam locations, types, and methods.
4. Type of installation.
5. Pattern type, repeat size, location, direction, and starting point.
6. Pile direction.
7. Type, color, and location of insets and borders.
8. Type, color, and location of edge, transition, and other accessory strips.
9. Transition details to other flooring materials.
10. Type of cushion.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet: 12-inch- square Sample.
2. Exposed Edge Stripping and Accessory-: 12-inch- long Samples.

D. Maintenance Data: Provided prior to installation of the carpeting and including the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet.

E. Submit printed VOC statement and product data for carpet and installation accessories in accordance with the General Administrative Requirements of the MSU Construction Standards 01300.1.2. Submit documentation for carpet materials of compliance with the Carpet and Rug Institute (CRI) Green Label Plus Testing Program www.carpet-rug.com/. Installation Adhesives Maximum VOC content when tested according to ASTM D 5116: 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h and also certified as compliant with CRI Green Label Plus testing program.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

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

B. All carpet shall be shipped to the site in original factory wrappings bearing labels verifying that all carpet is from the same dye lot. Carpet shall be delivered to the job site at least 48 hours prior to installation.

1.6 PROJECT CONDITIONS

A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."

B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Pattern: As indicated on drawings.

B. Fiber Content: Minimum 80% solution dyed nylon**.**

C. Face Construction: Level-loop pile or cut and loop pile.

D. Surface Pile Weight: Minimum 20 oz per sq yd.

E. Backing: Synthetic cushion.

F. Performance Characteristics: As follows:

1. Anti-static rating less than 3.0 KV.
2. Critical Radiant Flux Classification: ASTM E-648 Class I (Not less than 0.45 W/sq. cm.)
3. Methenamine Pill Test ASTM D 2859. Pass Doc FF 1-70, 16 CFR 1630.
4. Smoke Density: ASTM E-662 Dm. 0–450.

2.2 INSTALLATION ACCESSORIES

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

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by the carpet manufacturer or carpet cushion manufacturer, as appropriate:

C. Seaming Cement: Product recommended by carpet manufacturer for butting cut edges at backing to form secure seams and to prevent pile loss at seams.

D. Molding: Vinyl of appropriate width and height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the carpet manufacturer or carpet cushion manufacturer, as appropriate.
2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. For wood subfloors, verify the following:

1. Underlayment over subfloor complies with requirements specified in Division 6 Section "Rough Carpentry."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

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

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by the carpet manufacturer or carpet cushion manufacturer, as appropriate:

D. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Direct-Glue-Down Installation: Comply with CRI 104, Section 8, and “Direct Glue-Down Installation."

B. Double-Glue-Down Installation: Comply with CRI 104, Section 9, and “Double Glue-Down Installation."

C. Carpet with Attached-Cushion Installation: Comply with CRI 104, Section 10, and “Attached Cushion."

D. Comply with carpet manufacturer's written recommendations 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.

E. Do not bridge building expansion joints with carpet.

F. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

G. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

I. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRI 104, Section 15, and “Protection of Indoor Installations."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION 096800

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 M.S.U. ISSUES

A. LEED

1. For paints and coatings applied on the interior of buildings and applied on-site maximum VOC shall be in accordance with Green Seal Standard GS-11, Paints, First Edition, May 20, 1993.
   a. Flat paints and coatings: VOC content of not more than 50 g/L
   b. Non-flat paints and coatings: VOC content of not more than 150 g/L

2. Anticorrosive and anti-rust paints shall meet requirements of Green Seal Standard GC-03, Anti-corrosive Paints, Second Edition, January 7, 1997
   a. Anticorrosive coatings: VOC content of not more than 250 g/L

3. Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements shall meet requirements of South Coast Air Quality Managements District (SCAQMD Rule #1113.
   a. Varnish: VOC content of not more than 350 g/L
   b. Lacquer: VOC content of not more than 550 g/L
   c. Floor coatings: VOC content of not more than 100 g/L
   d. Shellacs (clear): VOC content of not more than 730 g/L
   e. Shellacs (pigmented): VOC content of not more than 550 g/L
   f. Stains: VOC content of not more than 550 g/L
   g. Sealers (waterproofing sealers): VOC content of not more than 250 g/L
   h. Sealers (sanding sealers): VOC content of not more than 275 g/L
   i. Sealers: (other than above listed) VOC content of not more than 200 g/L

4. Paints and coatings shall have a maximum of 1.0% of Total Aromatic Compounds (hydrocarbon compounds containing one or more benzene rings).

5. 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. Napthalene
w. Toluene (methylbenzene)
x. 1,1,1-trichloroethane
y. Vinyl chloride

B. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces, operating parts, and labels.

1. Pre-finished items NOT to be painted include the following factory-finished components:

a. Metal toilet enclosures
b. Acoustic materials
c. Architectural woodwork and casework
d. Elevator entrance doors and frames
e. Elevator equipment
f. Finished mechanical and electrical equipment
g. Light fixtures
h. Switchgear

2. Concealed surfaces NOT to be painted include wall or ceiling surfaces in the following generally inaccessible areas:

a. Foundation spaces
b. Furred areas
c. Utility tunnels
d. Pipe spaces
e. Duct shafts
f. Elevator shafts
g. Mechanical rooms

3. Operating parts NOT to be painted include moving parts of operating equipment such as the following:

a. Valve and damper operators
b. Linkages
c. Sensing devices
d. Motor and fan shafts

4. Finished metal surfaces NOT to be painted include:

    a. Anodized aluminum
    b. Stainless steel
    c. Chromium plate
    d. Copper
    e. Bronze
    f. Brass
    g. Galvanized steel (unless specifically designated to be painted)

5. Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating or nomenclature plates.

C. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and ironwork, and primed metal surfaces of mechanical and electrical equipment, in interior finished spaces only. Refer to Division 21 for additional fire protection painting requirements. Access panel covers must be painted separately, according to the following code: Electrical – orange, Communications – blue, Alarms – red.

D. Paint exposed surfaces whether or not colors are designated in paint schedules, except where a specific designation indicates the surface or material is not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the M.S.U. project representative will select from standard colors or finishes available.

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Concrete masonry units (CMU).
3. Steel.
4. Galvanized metal.
5. Aluminum (not anodized or otherwise coated).
6. Wood.
7. Gypsum board.
8. Plaster.
9. Cotton or canvas insulation covering.

B. Surface preparation, priming and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

C. Related Sections include the following:

1. Division 08 Sections for factory priming windows and doors with primers specified in this Section.
2. Division 21 Section WET-PIPE SPRINKLER SYSTEMS for fire protection painting.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, submitted to the M.S.U. Project Representative prior to project inception. List each material by the manufacturer's catalog number and general classification. The University retains the right to approve or disapprove any proposed equivalent paint products.

1. Submit printed VOC statements.
2. Submit printed aromatic compound statements.
3. Submit printed statements demonstrating that no restricted compounds are used.

B. Samples for initial color selection: in the form of manufacturer's color charts. After color selection, the M.S.U. project representative will furnish color chips for surfaces to be coated. It is the contractor's responsibility to provide the M.S.U. project representative with three draw downs of each product and color combination to be used for final approval.

C. Samples for Verification, when requested: For each type of paint system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. An actual color sample, 4' X 4', shall be painted on one wall of the jobsite for verification of actual wall color prior to any other painting. Actual color samples of other selected paints shall be painted on appropriate surfaces for verification as directed by the M.S.U. project representative.

E. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Federal Specification number, if applicable
4. Manufacturer's stock number and date of manufacture.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperature continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Keep storage area neat and orderly. Remove rags and waste from storage areas daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards from handling, mixing and application.
3. Paint/varnish removers shall be non-flammable.

1.5 PROJECT CONDITIONS

A. Apply water based paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperature of surfaces to be painted and ambient air temperatures are between 45 and 95 deg F.

C. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. The Glidden Co./PPG
2. O'Leary Paints (O'Leary
3. Sherwin-Williams Company (The).
4. Benjamin Moore & Co.
5. PPG

If products by manufacturers not listed above are recommended, they must be approved by M.S.U. at least 2 weeks prior to bidding.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

2.3 BLOCK FILLERS

A. High Performance Latex Block Filler: Used for filling open textured interior and exterior concrete block, above grade, before application of topcoats. This material should not be used in areas that are subject to continuous high moisture conditions such as daily washing, etc.

1. PPG: Devoe Bloxfill 4000-1000 Heavy Duty Acrylic Block Filler
2. O'Leary Paints: C946-11 Industrial Latex Block Filler
3. Sherwin-Williams Company (The): Heavy Duty Block Filler B42W46
4. Benjamin Moore & Co.: 206 Super Spec Masonry 100% Acrylic Hi-Build Block Filler.
5. PPG: Pitt-Glaze Interior/Exterior Block Filler 16-90

B. Severe Duty Two Component Epoxy Block Filler: Epoxy block filler used for filling open textured interior concrete block, before the application of high performance top coats. This filler should be used in all high moisture areas such as kitchens, showers, animal rooms, custodial wash areas, etc.

1. Devoe Tru-Glaze 4015 H P water borne 4015-1000
2. O'Leary Paints: 138-111-138-251B Acrylic Epoxy Block Filler
3. Sherwin-Williams Company (The): B42-WA8 WA9 or W42200/B42V201-Cement Plex
4. Benjamin Moore & Co.: M31/M32 Acrylic Epoxy Block Filler
5. PPG: Amerlock 400 BF Two-component epoxy masonry block filler

C. METAL PRIMERS

D. Synthetic Int., Rust-Inhibiting Acrylic Primer: Quick drying, rust-inhibiting primer for priming galvanized and ferrous and non-ferrous metal on the interior under acrylic paints and odorless alkyd semigloss or alkyd gloss enamels.

1. PPG: Devoe Devflex 4020 PF
2. O'Leary Paints: 36-11 180-11 Acrylic Metal Primer
3. Sherwin-Williams Company (The): Pro-Cryl B66 Series (W1310)
4. Benjamin Moore & Co.: P04 Super Spec HP Acrylic Metal Primer
5. PPG: Pitt-Tech Interior/Exterior Primer/Finish DTM 90-712/912 Series

E. Alkyd-Type Zinc Metal Primer: Primers used for priming galvanized and ferrous metals under acrylic or alkyd enamel finishes.

1. PPG: Pitt-Tech Interior/Exterior Primer/Finish DTM 90-712/912 Series
2. O'Leary Paints: 36-11 Acrylic Metal Primer
3. Sherwin-Williams Company (The): Pro-Cryl B66 Series(W1310)
4. Benjamin Moore & Co.: P04 Super Spec HP Acrylic Metal Primer

F. Non-Ferrous Metal Primer: Bonding type primer used to prime interior non-ferrous metal surfaces:

1. PPG: Devoe Devflex 4020PF
2. O'Leary Paints: 182 Industrial Acrylic DTM
3. Sherwin-Williams Company (The): DTM Bonding Primer B66A50, or Pro-Cryl B66 Series (W1310)
4. Benjamin Moore & Co.: (N023) Fresh Start Acrylic Primer
5. PPG: Pitt-Tech Interior/Exterior Primer/Finish DTM 90-712/912 Series

2.4 WOOD PRIMERS

A. Interior Latex Enamel Undercoat: Ready-mixed latex primer for use as an undercoat over wood and hardboard under latex enamel topcoat.

1. PPG/Glidden: Gripper Interior/Exterior Primer Sealer 3210
2. O'Leary Paints: L50 Block it
3. Sherwin-Williams Company (The): PrepRite ProBlock B51 Series (B51W620)
4. Benjamin Moore & Co.: (253) Super-Spec Latex Enamel Undercoater
5. PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921 Series

2.5 INTERIOR LATEX PRIMERS

A. Interior 100% Acrylic Primer: Acrylic primer used on plaster under flat, semigloss and gloss finishes. This primer must be specifically designed for application to plaster, gypsum drywall, block and masonry surfaces and over all alkyd paints as primer for re-coat.

1. PPG/Glidden: Gripper Primer Sealer 3210-1200
2. O'Leary Paints: L50 Block-it Acrylic Wall Primer
3. Sherwin-Williams Company (The): Loxon Primer LX02 Series (LX02W0050)
4. Benjamin Moore & Co.: N023 Fresh Start Acrylic Primer
5. PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921 Series

B. Wall-covering Primer: New drywall and plaster surfaces that are to receive a wall-covering finish are to be primed with heavy-duty acrylic primer to allow easy stripping of wall-coverings off of surfaces.

1. PPG/Glidden: Vapor Barrier Interior Primer Sealer 1060-1200
2. O'Leary Paints: Ultra-Prep L-490
3. Sherwin-Williams Company (The): PrepRite ProBlock B51 Series (B51W620)
4. Benjamin Moore & Co.: (N023) Fresh Start Acrylic Primer Sealer
5. PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921 Series

2.6 INTERIOR LATEX PAINTS

A. Interior/Exterior Acrylic Machinery Enamel Gloss: Premium quality gloss 100% acrylic enamel for use on interior and exterior metal and concrete surfaces where abrasion is a problem. This product shall have excellent adhesion characteristics even to existing alkyd finish coats and provide a smooth brush-mark free surface. TO BE USED ON METAL DOORS AND FRAMES. Use deep base and ultra deep base in the same product line.

1. PPG: Devoe DevFlex 4208
2. O'Leary Paints: L-8000 Duramax Acrylic Gloss
3. Sherwin-Williams Company (The): DTM Gloss B66W111
4. Benjamin Moore & Co.: P28 DTM Gloss
5. PPG: Pitt-Tech Plus Interior/Exterior Gloss DTM 90-374 Series -or-
   Pitt-Tech Plus Interior/Exterior High-gloss DTM 90-1310- Series

B. Interior/Exterior Acrylic Machinery Enamel Semi-Gloss: Premium quality semi-gloss 100% acrylic enamel for use on interior and exterior metal and concrete surfaces where abrasion is a problem. This product shall have excellent adhesion characteristics even to existing alkyd finish coats and provide a smooth brush-mark free surface. TO BE USED ON METAL DOORS AND FRAMES. Use deep base and ultra deep base in the same product line.

1. PPG: Devoe Devflex 4216 HP Acrylic DTM Semi-Gloss
2. O'Leary Paints: L 9000 Duramax Acrylic Semi-Gloss
3. Sherwin-Williams Company (The): DTM Semi-Gloss B66W211
4. Benjamin Moore & Co.: P29 Semi
5. Pitt-Tech Plus Int./Ext. Semi-gloss DTM Industrial Enamel 90-1210 Series

C. Acrylic DTM Semi-Gloss: Weather resistant, exterior acrylic semi-gloss for use on metal ducts, galvanized metals and ferrous and non-ferrous. Use deep base and ultra deep base in the same product line.

1. PPG: Devoe DevFlex 4216 HP Acrylic DTM Semi-Gloss
2. O'Leary Paints: 182 Industrial Acrylic DTM Semi G
3. Sherwin-Williams Company (The): DTM Acrylic Semi-Gloss B66W211
4. Benjamin Moore & Co.: P29 DTM Semi
5. Pitt-Tech Plus Int./Ext. Semi-gloss DTM Industrial Enamel 90-1210 Series

D. Latex Based Interior Semi-Gloss Latex Enamel: Low odor 100% acrylic or modified styrene acrylic, (NO VINYL ACRYLIC) latex enamel for use as a semi-gloss finish over primed concrete, concrete block, wood, plaster, and gypsum drywall. This product shall have abrasion resistance at least equal to 100% of the Leneta "C" Panel when tested in accordance with ASTM D2486. Use deep base and ultra deep base in the same product line.

1. PPG/Glidden: Diamond Semi-Gloss 7400
2. O'Leary Paints: L-2607 Pro-Tech Interior Latex Semi Gloss
3. Sherwin-Williams Company (The): Solo A76W53 100% Acrylic Semi-Gloss
   (Deep Base) 0 VOC B66-W663
   (Ultra Deep Base) 0 VOC B66-T664

4. Benjamin Moore & Co.: N376 Eco Spec WB Acrylic Semi Gloss
5. PPG: Manor Hall Interior Semi-gloss 82-500 Series

E. Latex Based Interior Eggshell Enamel: Low odor 100% acrylic or modified styrene acrylic, (NO VINYL ACRYLIC) latex enamel for use as an eggshell finish over primed concrete, concrete block, wood, plaster, and gypsum drywall. This product shall have abrasion resistance at least equal to 75% of the Leneta "C" Panel when tested in accordance with ASTM D2486. Use deep base and ultra deep base in the same product line.

1. PPG/Glidden: Diamond Eggshell 7200
2. O'Leary Paints: L-1007 Interior Latex Eggshell
3. Sherwin-Williams Company (The): Solo A75W53 100% Acrylic Eggshell
   (Deep Base) 0 VOC B66-W663
   (Ultra Deep Base) 0 VOC B66-T664
4. Benjamin Moore & Co.: N374 Eco Spec WB Acrylic Egg Shell
5. PPG: Manor Hall Interior Eggshell 82-300 Series

F. Latex Based Interior Flat Paint: Ready mixed, latex based paint for use over primed concrete, concrete block, wood, plaster, and gypsum drywall, acoustical plaster surfaces and as a "size" on cotton or canvas covering over insulation, and on all ceilings. Use deep base and ultra deep base in the same product line.

1. PPG/Glidden: Diamond Flat 7100
2. O'Leary Paints: 1400 Flat Ceramic Coat Latex Flat
3. Sherwin-Williams Company (The): Solo Flat 100% Acrylic A74W51
4. Benjamin Moore & Co.: N373 Eco Spec WB Acrylic Flat
5. PPG: Manor Hall Interior Flat 82-100 Series

2.7 INTERIOR EPOXY FINISHES

A. Acrylic Epoxy Gloss: Catalyzed acrylic epoxy gloss for use in areas of very high abrasion or where repetitive cleaning will be necessary.
1. O'Leary Paints: 138-1 Acrylic Epoxy Gloss G
2. Sherwin-Williams Company (The): B70W 211 B60 V-15, or Zero VOC WB Catalyzed Epoxy B73W311.
3. Benjamin Moore & Co.: P43 Super Spec HP Acrylic Epoxy Gloss

B. PPG: Pitt-Glaze WB Water-Borne Acrylic Epoxy 16-551 SeriesPolyamide Epoxy Gloss: Catalyzed polyamide epoxy gloss for use in areas where the maximum in abrasion, moisture and chemical resistance is required.
1. O'Leary Paints: 101 Polyamide Epoxy Gloss
2. Sherwin-Williams Company (The): B62-W101-V60 V70 Polyamide Epoxy Gloss, or WB Tile Clad B73W111.
3. Benjamin Moore & Co.: P36 Super Spec HP Acrylic Epoxy Gloss
4. PPG: Aquapon WB Water Base Epoxy 98-1 Series

2.8 INTERIOR WOOD FINISHING MATERIALS

A. Oil-Type Interior Wood Stain: Slow-penetrating oil-type wood stain for general use on interior wood surfaces under varnishes or was finishes.
1. PPG: Flood 1700 Wood Stain
2. O'Leary Paints: Old Masters, Finishes or Decorators Stains
3. Sherwin-Williams Company (The): Woodclassics 250 Stain A49 Series
4. Benjamin Moore & Co.: None
5. PPG: Deft Wood Stain

B. Paste Wood Filler: Solvent based, air-drying, paste type wood filler for use on open grain wood on interior wood surfaces.

1. O'Leary Paints: 50001 Old Master Wood Filler
2. Sherwin-Williams Company (The): Sher-wood Fast-Dry Filler D70T1
3. Benjamin Moore & Co.: (236) Benwood Paste Wood Filler

C. Interior Waterborne Urethane Satin: Clear, non-yellowing, water thinned, urethane sating, with excellent abrasion and moisture resistance. This product for use on interior stained or natural finished woodwork.

1. PPG: Wood Pride1802 Satin Urethane
2. O'Leary Paints: A4700-270 Waterborne Urethane
3. Sherwin-Williams Co. (The): Woodclassics Waterborne Polyurethane A-68 series V91
4. Benjamin Moore & Co.: (N423) Stays Clear Acrylic Urethane
5. PPG: Deft WB Poly Satin

2.9 SURFACE PREPARATION AGENTS: Paint and varnish removers shall be non-flammable.

A. Oil and Grease Emulsifier: Oil and grease emulsifier for cleaning walls, ceilings floors and equipment.

1. PPG: Devoe Devprep 88
2. O'Leary Paints: Coronado 93-500
3. Sherwin-Williams Company (The): Extra Muscle Cleaner
4. Benjamin Moore & Co.: P83 Oil & Grease Emulsifier
5. PPG: Duraprep Prep88 water-based alkaline cleaner

B. Epoxy and Urethane Remover: For stripping old epoxy or urethane coatings from surfaces to be re-coated.

1. O'Leary Paints: Star to Paste Stripper
2. Sherwin-Williams Company (The): Savagran Super-Strip
3. PPG: Duraprep Prep220 Commercial Coating Remover

C. Rust Removal and Metal Pre-treatment: For use in converting rust oxide and treatment of metal to promote coating adhesion.

1. O'Leary Paints: Coronado 93-300
2. Sherwin-Williams Company (The): Macroproxy 920 Pre-Prime B58T101
3. Benjamin Moore & Co.: None
4. PPG: Amerlock Sealer penetrating epoxy primer sealer

D. Concrete Etch: Concrete pre-treatment for use in removing the laitance and etching smooth concrete to improve coating adhesion.

1. O'Leary Paints: Coronado 93-400
2. Sherwin-Williams Company (The): Startex Muriatic Acid
3. Benjamin Moore & Co.: P85 Concrete Pre-treatment and Etch
4. PPG: DuraPrep 100 Concrete Etch

E. Rust Converter: For converting rust into a black protective film.

1. PPG: Devoe Preprime 167
2. O'Leary Paints: Coronado 93-900
3. Sherwin-Williams Company (The): Oshpo Rust Converter.
4. Benjamin Moore & Co.: P85 Rust Converter

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. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Plaster: 12 percent.
5. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, electrical panel box doors and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing, replacing, and/or repainting, as acceptable to the M.S.U. project representative. Provide “Wet Paint” signs to protect newly painted finishes. At completion of construction activities of other trades, touch up and restore all damaged or defaced painted surfaces.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall onto wet, newly painted surfaces.

2. Provide barrier coats over incompatible primers or remove and re-prime. Notify M.S.U. project representative in writing of problems anticipated with use of specified finish coat material with substrates primed by others.

D. Cementitious Material Substrates: Remove dust, dirt, grease, oil, release agents, curing compounds, efflorescence, and chalk.

1. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.
2. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
3. Clean concrete floors to be painted with a five percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, vacuum, rinse and allow drying before painting.

E. Steel Substrates: Clean non-galvanized ferrous-metal surfaces that have been shop coated: remove oil, grease, dirt, loose mill scale and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush; clean with solvents recommended by the paint manufacturer, and touch-up with the same primer as the shop coat.

F. Galvanized-Metal Substrates: Clean galvanized surfaces with non-petroleum-based solvents so the surface is free of oil and surface contaminants. Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. If galvanized metal is chromate passivated ("bonderized") consult manufacturers for appropriate surface preparation and primers.

G. Aluminum Substrates: Remove surface oxidation.

H. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
5. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately upon delivery.
6. Stripping and refinishing existing wood doors, trim, etc.

    a. Contractors shall take care to achieve clean and clear surfaces that will take stain uniformly. In some instances bleaching of the wood may be necessary. All existing varnish and stripping residue shall be removed and the surface neutralized and sanded smooth to assure a smooth and uniform finish.

I. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.

J. Exterior Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

K. Repainting: Prime coats may be omitted with the exception of patched or repaired areas that should be spot-primed to ensure a uniform finish. Special care should be taken in re-coating existing alkyd or epoxy surfaces to prevent inter-coat adhesion failures. Painting of patch and repair work shall be painted out to the nearest break line, including areas in corridors, as directed by the M.S.U. Project Representative.

L. Paint: Carefully mix and prepare paint materials in accordance with manufacturer's directions. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials or residue. Stir material before application to produce a mixture of uniform density; stir as required during application. Remove any surface film and, if necessary, strain material before using. Do not stir surface film into material. Use only thinners approved by the paint manufacturer and only within recommended limits.

M. Tinting: Where multiple coats of the same material are applied, tint undercoats to match the color of the finish coat, but in a sufficiently lighter shade to distinguish each separate coat.

3.3 APPLICATION

A. Paint colors, surface treatments, and finishes are indicated in schedules. Provide finish coats that are compatible with primers used.

B. Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been primed by others. Re-coat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

C. Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer. Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

D. Apply paints according to manufacturer's written instructions. Use applicators and techniques best suited for paint and substrate indicated. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

E. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required in order to produce and even, smooth surface in accordance with the manufacturer's directions. Sand lightly between each succeeding enamel or varnish coat

F. Apply first coat to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

G. The term "exposed surfaces" includes areas visible when a permanent or built-in fixture, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

H. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

I. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

J. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

K. All materials will be applied under adequate lighting, evenly spread and flowed on smoothly. Cut in sharp lines and color breaks.

1. Pigmented (opaque) finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and overage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable.
2. Transparent (clear) finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

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

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

3.5 INTERIOR PAINTING SCHEDULE

A. Concrete and Masonry (other than Concrete Masonry Units):

1. Semi-Gloss Latex Finish:
   a. Two coats latex semi-gloss over a primer. This system for use on surfaces that are not subject to high abrasion or continuously moist conditions.

      1) Prime Coat: Interior 100% Acrylic Primer
      2) Intermediate Coat: Latex Based Interior Semi-Gloss Latex Enamel
      3) Intermediate Coat: Latex Based Interior Semi-Gloss Latex Enamel

2. Polyamide Epoxy Gloss Finish:

   a. Two coats over epoxy sealer, total dry film thickness of the two finish coats not less than 4.0 total mils. This system to be used in all areas that are exposed to chemical attract, constant moisture or frequent washing.

      1) Prime Coat: Epoxy Sealer
      2) Intermediate Coat: Polyamide Epoxy Gloss
      3) Intermediate Coat: Polyamide Epoxy Gloss

B. Concrete Masonry Units Substrates:

1. Semi-Gloss Latex Enamel Finish:

a. Two coats over block filler. This system for use on surfaces that are not subject to high abrasion or continuously moist conditions.

1) Prime Coat: High Performance Latex Block Filler
2) Intermediate Coat: Latex Based Interior Semi-Gloss Latex Enamel
3) Topcoat: Latex Based Interior Semi-Gloss Latex Enamel

2. Semi-Gloss Alkyd Enamel Finish:

a. Two coats over block filler with total dry film thickness not less than 3.5 mils, excluding the block filler.

1) Prime Coat: High Performance Latex Block Filler
2) Intermediate Coat: DTM Alkyd Semi-Gloss Enamel
3) Topcoat: DTM Alkyd Semi-Gloss Enamel

3. Polyamide Epoxy Gloss Finish:

a. Two coats over block filler, total dry film thickness of the two finish coats not less than 4.0 mils. This system to be used in all areas that are exposed to constant moisture or frequent washing.

1) Prime Coat: Severe Duty Two Component Epoxy Block Filler
2) Intermediate Coat: Polyamide Epoxy Gloss
3) Topcoat: Polyamide Epoxy Gloss

C. Ferrous (and Non-Ferrous, Galvanized, and Aluminum) Metal Substrates:

a. Semi-Gloss Acrylic System

1) Two coats over primer with total dry film thickness not less than 2.5 mils.

a) Prime Coat: Acrylic Zinc Metal Primer
b) First Coat: DTM Acrylic Semi-Gloss Enamel
c) Second Coat: DTM Acrylic Semi-Gloss Enamel

D. Gypsum Drywall Systems:

1. Lusterless (Flat) Emulsion System

a. Two coats. Flat latex finish with good washability and excellent touch-up characteristics. This system to be used only on ceilings, or on wall surfaces that are above eight feet high.

1) Prime Coat: Interior 100% Acrylic Primer
2) Topcoat: Latex Based Interior Flat Paint

2. Latex Interior Eggshell System

    a. Two coats over primer

        1) Prime Coat: Interior 100% Acrylic Primer
        2) Intermediate Coat: Latex Based Interior Eggshell Enamel
        3) Topcoat: Latex Based Interior Eggshell Enamel

3. Latex Interior Semi-Gloss System

    a. Two coats over primer

        1) Prime Coat: Interior 100% Acrylic Primer
        2) Intermediate Coat: Latex Based Interior Semi-Gloss Latex Enamel
        3) Topcoat: Latex Based Interior Semi-Gloss Latex Enamel

4. Odorless Acrylic Enamel Semi-Gloss System

    a. Three coats with total dry film thickness not less than 2.5 mils.

        1) Prime Coat: Interior 100% Acrylic Primer
        2) Intermediate Coat: DTM Acrylic Semi-Gloss Enamel
        3) Topcoat: DTM Acrylic Semi-Gloss Enamel

5. Polyamide Epoxy Gloss System

    a. Two coats over Interior 100% Acrylic Primer, total dry film thickness of the two finish coats not less than 2.5 mils. This system to be used for drywall and plaster surfaces that are exposed to constant moisture or frequent washing.

        1) Prime Coat: Interior 100% Acrylic Primer
        2) Intermediate Coat: Polyamide Epoxy Gloss
        3) Topcoat: Polyamide Epoxy Gloss

E. Plaster Systems:

1. Lusterless (Flat) Emulsion System

    a. Two coats. Flat latex finish with good washability and excellent touch-up characteristics. This system to be used only on ceilings, or on wall surfaces that are above eight feet high.

        1) Prime Coat: Interior 100% Acrylic Primer
        2) Finish Coat: Latex Based Interior Flat Paint

2. Latex Interior Eggshell System

    a. Two coats over primer

        1) Prime Coat: Interior 100% Acrylic Primer
        2) Intermediate Coat: Latex Based Interior Eggshell Enamel
        3) Topcoat: Latex Based Interior Eggshell Enamel

3. Latex Interior Semi-Gloss System

    a. Two coats over primer

        1) Prime Coat: Interior 100% Acrylic Primer
        2) Intermediate Coat: Latex Based Interior Semi-Gloss Latex Enamel
        3) Topcoat: Latex Based Interior Semi-Gloss Latex Enamel

4. Polyamide Epoxy Gloss System

    a. Two coats over Interior 100% Acrylic Primer, total dry film thickness of the two finish coats not less than 4.0 mils. This system to be used for drywall and plaster surfaces that are exposed to constant moisture or frequent washing.

        1) Prime Coat: Interior 100% Acrylic Primer
        2) Intermediate Coat: Polyamide Epoxy Gloss
        3) Topcoat: Polyamide Epoxy Gloss

F. Woodwork and Hardboard System:

1. Semi-Gloss Enamel Finish:

    a. Three coats

        1) Undercoat: Acrylic Enamel Undercoat
        2) First Coat: DTM Acrylic Semi-Gloss Enamel
        3) Second Coat: DTM Acrylic Semi-Gloss Enamel

G. Stained Woodwork System:

1. Three finish coats over stain

    a. Stain Coat: Oil-Type Interior Wood Stain
    b. First Coat: Interior Waterborne Urethane Satin
    c. Second Coat: Interior Waterborne Urethane Satin
    d. Third Coat: Interior Waterborne Urethane Satin

H. Problem Areas:

1. Glazed Tile, Ceramic, Porcelain, Tile, Glass, and Marble

   a. First Coat: Acrylic Bonding Primer
   b. Second Coat and Top Coat (required): Use appropriate systems as specified.

2. Damp Areas, Boiler Rooms, etc./ Pipes, Concrete, Walls, and Ceilings

   a. First Coat: Acrylic Moisture Bond Primer
   b. Second Coat: Acrylic Moisture Bond Enamel

3. Commercial Kitchens, Public Restrooms, Animal Care Areas, Shower Rooms, etc. Areas where high abuse and daily cleaning occur.

   a. Primer/First Coat:

      1) Masonry surfaces: Severe Duty Two Component Epoxy Block Filler
      2) Plaster and Drywall Surfaces: Interior 100% Acrylic Primer

   b. Second and third coats: Acrylic Epoxy Gloss or Polyamide Epoxy Gloss

4. Handicap ramps, steps, areas where anti-slip coatings may be required:

   a. Surface preparation: Acid-etch concrete if required. Prime if previously painted.
   b. First Coat: Epoxy Modified Acrylic Anti-slip Coating
   c. Second Coat: Epoxy Modified Acrylic Anti-slip Coating

END OF SECTION 099123

SECTION 122400 - WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior manual roller shades.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

B. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

C. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum 3 years of documented experience with shading systems of similar size and type.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.6 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

A. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: One year.
   2. Fabric: One year.
   3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. As indicated in drawings on Finish Legend
   2. Or Equal, as determined by the Owner and Architect.

2.2 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades:
   1. Basis of Design: As Indicated in drawings on Finish Legend
   2. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Roll Direction: Roll down, closed position is at window sill.
      c. Mounting: Wall mounted.
      d. Size: As indicated on drawings.
      e. Fabric: As indicated on drawings
   3. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
      a. Material: Stamped steel.
   4. Roller Tubes: As required for type of shade operation.
      a. Material: Extruded aluminum, clear anodized finish.
      b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
      c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
   5. Hembars: Designed to maintain bottom of shade straight and flat.
      a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.

6. Manual Operation for Interior Shades:
   a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
   b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.
   c. Shade Lift Assistance: Manufacturer's standard spring device contained in the idler end of roller tube to reduce force required to lift shades; as required based on shade weight.
   d. Chain Retainer:
      1) Chain tensioning device complying with WCMA A100.1.
      2) Manufacturer's standard clip.
7. Accessories:
   a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.
      1) Color: As indicated on Finish Legend.
      2) Profile: Square.

2.3 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: As recommended in writing by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.4 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.5 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 122400

SECTION 123600 - COUNTERTOPS AND WINDOW SILLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Wall-hung counters

1.2 SUBMITTALS

A. See Division 01 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.

C. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

D. Installation Instructions: Manufacturer's installation instructions and recommendations.

E. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than five years of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.5 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
   1. In the absence of written recommendations by the manufacturer do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants for the previous 72 hours as well as the remainder of the construction period.

B. Verify dimensions of adjacent construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 PRODUCTS

2.1 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   1. If the Contract Documents contain requirements that are more stringent than the referenced quality standard, comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
   1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
      a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      b. Manufacturer and Finish: As indicated on Drawings.
      c. Surface Color and Pattern: As indicated on drawings.
   2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch thick; covered with matching laminate.
   3. Back and End Splashes: Same material, same construction.

2.2 MATERIALS

A. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

C. Joint Sealant: Mildew-resistant silicone sealant, color as selected by Architect.

D. Grommets: Doug Mockett & Company, Inc.; MM6 Grommet Cap. Finish as selected by Architect.

E. Wall Mounted Countertop Brackets: Rakks / Rangine Corporation; www.rakks.com.
   1. Surface Mount: EH Surface Series.
   2. Flush Mount: EH Inside Mount Series.
   3. ADA Vanity Bracket: EHV Vanity Bracket.
   4. Finish: Factory primed, field paint to match wall color.

2.3 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets as indicated on drawings except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
      a. At cutouts, seal edges of supporting substrate.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.

C. Plastic Laminate Tops: Provide plastic-laminate backer sheet, NEMALD3, GradeBKL, on underside of countertop substrate.

D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.

C. Seal joint between back/end splashes and vertical surfaces.

3.4 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.5 CLEANING

A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 123600

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Sleeves.
3. Escutcheons.
4. Fire-suppression equipment and piping demolition.
5. Equipment installation requirements common to equipment sections.

1.3 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.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.6 COORDINATION

A. Arrange for pipe spaces in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Panels."

D. Coordinate systems shutdown (water, fire protection, hot water heating, steam, chilled water, etc.) with MSU Project Manager/MSU Project Representative. Activation and shut down of existing systems shall be conducted by MSU personnel only.

PART 2 - PRODUCTS

2.1 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.

2.2 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.4 ESCUTCHEONS

A. Description: Plastic wall and ceiling escutcheons, with an ID to closely fit around pipe and an OD that completely covers opening.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

A. Refer to Division 01 for cutting and patching and Division 02 Section "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. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls and ceilings. Paint escutcheons to match the adjoining wall or ceiling.

M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Sleeves placed in floors shall be flush with the ceiling and shall have planed, square ends, extending 2 inches above the finished floor, unless otherwise specified or detailed.
2. Where sleeves pass through reinforced concrete floors, they shall be properly set in position before the concrete is poured, and shall be maintained in position by the Contractor until the concrete is set.
3. Sleeves placed in concrete beams shall be flush with the side of the beam and large enough to accommodate the bare pipe only. All other sleeves shall be of adequate size to accommodate pipe insulation undiminished in size.
4. Pipes passing through above grade floor slabs and masonry walls shall have the space between the pipe or insulation and the sleeve packed with non-asbestos wicking or other suitable, approved, non-combustible material.
5. Pipes passing through walls of Mechanical Equipment Rooms shall be made gas-tight by caulking the space between the pipe and sleeve with a fiber saturated with an approved type of plastic material.

6. Install sleeves in new walls and slabs as new walls and slabs are constructed.
7. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

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 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. 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.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

B. Field Welding: Comply with AWS D1.1.

END OF SECTION 210500

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

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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

1. Kinetics Noise Control.
2. Mason Industries.
3. Vibration Eliminator Co., Inc.
4. Vibration Isolation.
5. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

3.3 VIBRATION-CONTROL INSTALLATION

A. 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.

B. 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
4. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

END OF SECTION 210548

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Sprinklers.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

1.4 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.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Delegated Design: Design sprinkler system(s) per NFPA 13-2013, FM Global and additional design criteria on documents where indicated.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

D. Sprinkler system shall be hydraulically designed as specified.

1.6 SUBMITTALS

A. Review Procedure for Projects involving with classrooms:

1. Contractor shall submit the shop drawings, working plans including product data and hydraulic calculations where applicable, to the Factory Mutual (FM) Global and Architect/Engineer (A/E) for their review, and to MSU Fire Marshall and IPF Planning, Design and Construction (PDC) for their record. Review shall be based on applicable NFPA Standards, current version or as specified in the construction document.
2. FM Global shall provide review comments back to the A/E, MSU Fire Marshall and PDC.
3. A/E shall consult with MSU PDC prior to applying comments from the FM Global, and return the shop drawings with review comments back to the Contractor. Repeat the process until the A/E approves the submittals.
4. Contractor shall submit the A/E approved shop drawings to the State of Michigan Office of Fire Safety for final approval prior to installation.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

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

E. Welding certificates.

F. 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."

G. Field quality-control reports.

H. Operation and Maintenance Data: For sprinkler specialties to include in operation and maintenance manuals.

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

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

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

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Owner's written permission.

1.9 COORDINATION

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

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and 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. Hot dipped galvanized where indicated. 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, hot dipped galvanized where indicated.

C. Steel Couplings: ASTM A 865, threaded, hot dipped galvanized where indicated.

D. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern, hot dipped galvanized where indicated.

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. Shurjoint Piping Products.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.

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

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type 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 SPRINKLERS

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

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. 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 (1200 kPa) minimum.
3. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig (1725 kPa) minimum.
4. Temperature Rating: 165 deg. F unless otherwise indicated.

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 (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
4. Element Type: Glass bulb.

D. Sprinkler Finishes:

1. Painted.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Refer to Division 21 Section "Common Work Result for Fire Suppression" for basic installation requirements.

B. 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.

C. Piping Standard: Comply with requirements for installation of sprinkler piping 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 (DN 50) and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) 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 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) 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. 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.

I. 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.

J. 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.

3.3 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

3.4 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."

3.5 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.8 PIPING SCHEDULE

A. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 (DN 65) and larger, shall be the following:

1. 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.
2. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.9 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.

END OF SECTION 211313

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Plumbing demolition.
6. Equipment installation requirements common to equipment sections.
7. Supports and anchorages.

1.3 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. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

D. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

C. Certificate of Acceptance: Provide certificate as described in this section.

1.5 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."

C. Permits and Inspections

1. The Plumbing Contractor shall obtain and pay for all permits required by the State of Michigan Department of Licensing and Regulatory Affairs, Plumbing Division.

2. The Plumbing Contractor shall submit, to precede request for final payment, a copy of the Certificate of Acceptance of the plumbing systems.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Panels."

D. Coordinate systems shutdown (water, fire protection, hot water heating, steam, chilled water, etc.) with MSU Project Manager/MSU Project Representative. Activation and shut down of existing systems shall be conducted by MSU personnel only.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 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.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASTM A-354 Grade BD and SAE J-429 Grade 8 for steam and condensate application, and ASTM A-354 and SAE J-429 Grade 5 for other low service temperature applications, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys, 95/5 tin-copper. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Link-Seal.
b. Metraflex Co.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, plain ends.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 for 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. T-drill system for mechanically formed tee connections and couplings, and Victaulic hole cut piping system are not allowed.

J. Install piping to allow application of insulation.

K. Piping shall not project beyond walls or steel lines nor shall it hang below slabs more than is absolutely necessary. Particular attention shall be paid to the required clearances.

L. Offset piping where required to avoid interference with other work, to provide greater headroom or clearance, or to conceal pipe more readily. Offsets shall be properly drained or trapped where necessary.

M. Provide swing joints and expansion bends wherever required to allow the piping to expand without undue stress to connections or equipment.

N. Isolate pipe from the building construction to prevent transmission of vibration to the structure and to eliminate noise.

O. Exposed piping around fixtures or in other conspicuous places shall not show tool marks at fittings.

P. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

Q. Select system components with pressure rating equal to or greater than system operating pressure.

R. Eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur due to a reduction in pipe size. Eccentric couplings shall make the pipe flush on the top for water lines.

S. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
d. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
e. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
f. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

T. Install sleeves for pipes passing through concrete and masonry walls and concrete floor slabs.

1. Sleeves placed in floors shall be flush with the ceiling and shall have planed, square ends, extending 2 inches above the finished floor, unless otherwise specified or detailed.
2. Where sleeves pass through reinforced concrete floors, they shall be properly set in position before the concrete is poured, and shall be maintained in position by the Contractor until the concrete is set.
3. Sleeves placed in concrete beams shall be flush with the side of the beam and large enough to accommodate the bare pipe only. All other sleeves shall be of adequate size to accommodate pipe insulation undiminished in size.
4. Pipes passing through above grade floor slabs and masonry walls shall have the space between the pipe or insulation and the sleeve packed with non-asbestos wicking or other suitable, approved, non-combustible material.
5. Pipes passing through walls of Mechanical Equipment Rooms shall be made gas-tight by caulking the space between the pipe and sleeve with a fiber saturated with an approved type of plastic material.

U. 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.

V. Verify final equipment locations for roughing-in.

W. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

X. Return hot water line shall be no further than 15’ from the fixture needing hot water.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

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.

B. Unions shall be used in preference to couplings where their use will facilitate dismantling the pipe for maintenance.

C. Install transition couplings at joints of dissimilar piping.

D. No Uni-flange pipe adapters will be allowed.

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. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1.

END OF SECTION 220500

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Cast iron 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.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B31.9 for building services piping valves.

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

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

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

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

D. Valves in Insulated Piping: With 2-inch (50-mm) 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.

E. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. 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. Apollo Valves; Model #77C-100 or 77C-200.
b. Crane Co.; Crane Valve Group; Crane Valves; Model #9302 or 9302S.
c. Hammond Valve; Model #8501, 8301A or 8511, 8311A.
d. Milwaukee Valve Company; Model #BA-400 or BA-450.
e. NIBCO INC; Model #T585-70 or S585-70.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
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.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 CAST IRON BALL VALVES

A. Two-Piece, Full-Port, Cast Iron Ball Valves with Stainless-Steel Trim:

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

a. Conbraco Industries, Inc.; Apollo Valves; Model 6PLF (Lead Free)
b. Approved equal

2. Description:

a. Standard: MSS SP-72.
b. SWP Rating: 125 psig.
c. CWP Rating: 200 psig.
d. Body Design: Two piece.
e. Body Material: Class 125 Cast Iron.
f. Ends: Threaded.
g. Seats: PTFE .
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
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 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 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service:

a. 6” and smaller: 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 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 (DN 65) and Larger: Flanged ends.
3. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 (DN 65): Flanged ends.
5. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) 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 brass, bronze or stainless-steel trim.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron, Ball Valves: 200 CWP, stainless steel trim.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

1.5 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Clevis.
2. Fee and Mason.
3. Anvil.
4. PHD Manufacturing, Inc.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of hot dip galvanized or cadmium plated.

2.3 TRAPEZE PIPE HANGERS

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

2.4 THERMAL-HANGER SHIELD INSERTS

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

1. PHS Industries, Inc.
2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa).

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa).

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 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.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 EQUIPMENT SUPPORTS

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

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal 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 the building structure.

B. Metal 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 for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick 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.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

A. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

B. Install hangers and supports to allow controlled thermal 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.

C. Install lateral bracing with pipe hangers and supports to prevent swaying.

D. 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 (DN 65) and larger and at changes in direction of piping.

E. Holes shall not be drilled or punched in beams and supporting members. Do not support piping from roof deck, other piping, ducts or equipment.

F. Hangers and supports shall also be provided at every change of direction and within 1' of any pipe fittings and valves.

G. Pipe hangers in fan rooms and in mechanical equipment rooms shall be provided with suitable vibration isolation units to eliminate noise transmission between the piping and the building structure.

H. Hanger components shall not be used for purposes other than for which they were designed.

I. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.

J. Where negligible movement of pipe occurs at hanger locations, rod hangers may be used for suspended lines. For piping supported from below, bases, brackets or structural cross members may be used.

K. If the vertical angle of the hanger is greater than 4 degrees, a traveling device shall be provided for horizontal movement. For piping supported from below, rollers or roller carriages shall be used.

L. Where significant vertical movement of the pipe occurs at the hanger location, a resilient support shall be used. Spring Cushion Hangers may be used where vertical movement does not exceed 1/4".

M. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

N. Riser Supports

1. On a riser subject to expansion, only one support of the rigid type shall be used.
2. Riser clamps shall have a positive means of engagement between the pipe and the clamp.
3. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.

O. Anchors, Guides and Restraints: Anchors, guides and restraints shall be provided wherever necessary to support risers, to maintain pipe in position, and to properly distribute expansion.

P. Supplemental Framing: Supplemental framing, angles, channels or beams, shall be provided where the anchor locations do not align with the building structure or where the intended loads exceed the structural framing maximum load carrying capacity.

Q. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

R. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

S. Insulated Piping:

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 allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
    b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

T. Plastic Pipe Hanger Installation:

1. Rigid plastic piping shall normally be supported by the same type of hangers used with steel pipe. In pressure application, hangers shall be provided with pads or cushions on the bearing surfaces.
2. Flexible plastic tubing shall be supported continuously by metal angles or channels with special hangers.

U. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

3.2 ADJUSTING

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

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.3 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are 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 carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Use of "C" clamps and beam clamps of "C" pattern and any modifications thereof is prohibited.

K. 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 (DN 15 to DN 750).
2. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
3. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
4. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

5. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
6. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
7. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
8. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
9. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

L. 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 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

M. 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 (150 mm) for heavy loads.
2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

N. 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. Use of "C" clamps and beam clamps of "C" pattern and any modifications thereof is prohibited.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles. Use only when it is not possible to use center loading beam clamps. Subject to prior approval by the A/E.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
6. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
7. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

O. 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.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Stencils.
4. Valve tags.

1.3 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Emed.
2. Marking Services Inc.
3. Seton Name Plate Co.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. 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 (38 mm) high.

2.3 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

2.4 VALVE TAGS

A. Valve Tags: 1-1/2” diameter round with 3/16” top hole, stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: #16 solid brass jack chain.
3. No painted tags will be accepted.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

C. Number sequences shall be from 1 thru 999 with top line legends as follow:

1.	Domestic Cold Water	CW
2.	Domestic Hot Water	HW
3.	Domestic Hot Water Return	HWR
4.	Compressed Air	A
5.	Natural Gas	GAS
6.	Vacuum	VAC

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. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

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. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
7. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.

C. Pipe Label Legends:

1. General Services

    a. Compressed Air – Control
    b. Compressed Air – Laboratory
    c. Deionized Water Supply
    d. Deionized Water Return

e. Domestic Cold Water
f. Domestic Hot Water Supply
g. Domestic Hot Water Return
h. Natural Gas
i. Sanitary Waste
j. Storm - Primary
k. Storm - Overflow
l. Vacuum – Cleaning
m. Vacuum – Laboratory
n. Vent

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves shutoff valves; faucets; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. All valves and regulators (except those directly serving equipment) shall be provided with a brass tag securely wired in place on the valve stem below the packing gland nut. Tags shall clearly indicate the part of system, or room name and/or number controlled by the valve.

C. Furnish four (4) hot-press laminated typewritten copies of valve schedule, giving valve number controlled by the valve and location of valve. One copy will be mounted on a directory board in the main mechanical room, and one copy will be placed in each of the three mechanical brochures.

D. Where it is necessary to operate more than one valve to control a section of piping, this fact and the numbers of the secondary valves shall be noted on the directory.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

    a. Mineral fiber.

2. Adhesives.
3. Sealants.
4. Factory-applied jackets.
5. Tapes.
6. Securements.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
3. Detail removable insulation at piping specialties, equipment connections, and access panels.
4. Detail field application for each equipment type.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

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. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Duct Wrap.
    d. Owens Corning; All-Service Duct Wrap.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; Micro-Lok.
    b. Knauf Insulation; 1000 Pipe Insulation.
    c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive and FSKJacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
4. Color: White or gray.
5. For indoor applications, use sealants 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 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.5 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

2.6 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.
2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy or 0.062-inch (1.6-mm) soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 (50 mm) 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 (100 mm) 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. Handholes.
5. Cleanouts.

3.4 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 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 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. 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 (50 mm) 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.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 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. Vertical portions of the sanitary drains.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

C. Insulate cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self sealing laps.

1. Domestic cold water.
2. Horizontal portions of the sanitary drain.

3.8 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. All pipe sizes: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (13 mm) thick.

2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1.5 inch (25 mm) thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
c. Polyolefin: 1/2 inch (13 mm) thick.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Aboveground domestic water pipes, tubes, and fittings inside buildings.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Construction Representative no fewer than seven days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Construction Representative's written permission.

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.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61.

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

2.3 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Manufacturers:

a. Central Plastics Company.
b. Watts Industries, Inc.; Water Products Div.
c. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Central Plastics Company.
b. Watts Industries, Inc.; Water Products Div.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Lochinvar Corp.

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.

1. Manufacturers:

a. Perfection Corp.; Clearflow Dielectric Waterway.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Refer to Division 22 Section “Common Work Results for Plumbing” for basic installation requirements.

B. 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.

C. Install eccentric reducing couplings, flush on the top for water lines, where air or water pockets would otherwise occur due to a reduction in pipe size.

D. Cap and plug all openings in pipes with suitable metal plugs or cap to keep out dirt and rubbish during construction until equipment is connected.

E. Install domestic water piping level without pitch and plumb.

F. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment. Use ball for piping NPS 6 and smaller.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. 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: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

E. 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.

F. Flanged Joints: Select appropriate asbestos-free gasket material, size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

1. NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.
2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric nipples.
3. NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

A. 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, riser clamps.
2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.

E. Install supports for vertical copper tubing every 10 feet (3 m).

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.

G. Install supports for vertical steel piping every 15 feet (4.5 m).

H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 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. Pipe sizes indicated shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of the equipment. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valves.

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.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.8 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 (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow standing 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.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Open shutoff valves to fully open position.
2. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
3. Remove and clean strainer screens. Close drain valves and replace drain plugs.
4. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. All piping shall be cleaned before the installation, and flushed after the installation and before system startup.

B. Equipment, detergents, solvents and other cleaning agents shall be furnished by a qualified water treatment services.

C. 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. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

D. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

E. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 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. Fitting Option: Brazed joints may be used on aboveground copper tubing. Extruded-tee connections are prohibited.

D. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought- copper solder-joint fittings; and soldered joints.

E. Aboveground domestic water piping, NPS 2-1/2 and larger, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); grooved-joint copper-tube appurtenances; and grooved joints.

3.12 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 6 and smaller.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Air vents.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 ACTION SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.2 AIR VENTS

A. Manual Air Vents:

1. Manufacturers:

a. Bell & Gossett; No. 4V

2. Type: Loosed key screwdriver stop.
3. Pressure Rating: 150 psi minimum pressure rating at 250 degree F.
4. Material: Stainless steel.
5. Connections: 1/2” FPT / 3/4” MPT.

B. Automatic Air Vents:

1. Manufacturers:

a. Bell & Gossett; No. 4V

2. Material: Brass body with non-ferrous internals.
3. Pressure Rating: 150 psi minimum pressure rating at 240 degree F.
4. Connections: 1/2” FPT / 3/4” MPT.

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 air vents at high points of water piping.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 FIELD QUALITY CONTROL

A. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Sections include the following:

1.3 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.

1.4 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPING MATERIALS

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

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

a. ANACO-Husky; Series 4000.
b. Clamp-All Corp.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

C. Adhesive Primer: ASTM F 656.

D. Solvent Cement: ASTM D 2564.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. 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."

C. 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 cast iron increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

D. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

E. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

F. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.2 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10 mm) minimum rods.

E. 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 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and 5 (DN 100 and 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

H. Install supports for vertical PVC piping every 48 inches (1200 mm).

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.4 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.5 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.6 FIELD QUALITY CONTROL

A. Drainage system shall be inspected and tested in accordance with State of Michigan Plumbing Code.

B. 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.

C. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.7 CLEANING AND PROTECTION

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 PIPING SCHEDULE

A. Aboveground, soil and waste piping shall be any of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

B. Aboveground, vent piping shall be any of the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Faucets
2. Protective shielding guards.
3. Fixture supports.
4. Lavatories.

1.3 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

C. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 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. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

E. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Vitreous-China Fixtures: ASME A112.19.2M.

F. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Faucets: ASME A112.18.1.
2. Hose-Connection Vacuum Breakers: ASSE 1011.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
5. NSF Potable-Water Materials: NSF 61.
6. Pipe Threads: ASME B1.20.1.
7. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
8. Supply Fittings: ASME A112.18.1.
9. Brass Waste Fittings: ASME A112.18.2.

G. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Hose-Coupling Threads: ASME B1.20.7.
3. Off-Floor Fixture Supports: ASME A112.6.1M.
4. Pipe Threads: ASME B1.20.1.
5. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 GENERAL

A. The earthenware of all fixtures must be unmarked, true and level. Vitreous ware shall be warranted not to craze, discolor or scale.

B. All faucets and exposed traps, fittings, trim, connections, etc., for fixtures, shall be of polished chromium plated brass unless specified otherwise.

2.2 LAVATORY FAUCETS

A. Lavatory Faucets (single lever manual faucet)

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

   a. Chicago Faucets 420-T41ABCP
   b. T & S Brass and Bronze Works, Inc

2. Description: ADA Compliance. Single Lever 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: Commercial, solid brass.
   b. Finish: Chrome plate.
   c. Maximum Flow Rate: 0.5 gpm.
   d. Centers: 4 inches.
   e. Mounting: Deck, exposed.
   f. Valve Handle(s): Lever, 4 inches.
   g. Inlet(s): NPS 1/2 male shank.
   h. Spout: Rigid type.
   i. Spout Outlet: Aerator.
   j. Operation: Non-compression, manual.
   k. Drain: Grid.
   l. Tempering Device: Thermostatic ceramic

2.3 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

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

    a. Plumberex Specialty Products Inc.
    b. TRUEBRO, Inc.
    c. 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.

2.4 FIXTURE SUPPORTS

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

1. Josam Company.
2. Smith, Jay R. Mfg. Co.
3. Tyler Pipe; Wade Div.
4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
5. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Lavatory Supports:

1. Description: Concealed arms with non-slip locking devices for wall-mounting. Include rectangular steel uprights with feet.
2. Basis-of-Design Product: Wade Model W-520.

2.5 LAVATORIES

A. Lavatories:

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

    a. American Standard Companies, Inc.
    b. Kohler Co..
    c. Zurn Commercial Plumbing Fixtures.

2. Description: ADA Compliance, wall-mounting, vitreous-china fixture.

    a. Type: Counter mount.
    b. Size: As specified.

c. Faucet Hole Punching: Three holes, 4-inch centers.
d. Faucet Hole Location: Top.
e. Pedestal: Not required.
f. Color: White.
g. Faucet: As specified.
h. Supplies: NPS 3/8 chrome-plated copper with stops.
i. Drain: Grid.
j. Drain Piping: NPS 1-1/4 chrome-plated, P-trap; NPS 1-1/4, 17 gauge thick tubular brass waste to wall; and wall escutcheon.
k. Hair Interceptor: Not required
l. Protective Shielding Guard(s): Supplies as required.
m. Fixture Support: As specified.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

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

3.2 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 counter-mounting fixtures in and attached to casework.

D. Install fixtures level and plumb according to roughing-in drawings.

E. 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.

1. Exception: Use ball valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

F. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

G. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

H. 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.

I. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

J. 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.

K. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

L. 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."

M. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant unless indicated otherwise. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

N. Install fixtures complete with all supply, soil, waste and vent piping connections; together with all fittings, fastening devices, cocks, valves and appurtenances required to effect complete and serviceable installations.

3.3 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.

1. Supply Risers: Formed metal nosepiece with insert or formed nosepiece with insert gasket by Brass Craft or approved equal. Rubber gasket type compression fitting is not acceptable.
2. Supply Stops: Brasscraft KT series ¼ turn ball stop, polished chrome-plated, stuffing box or loose-key, straight or angle style with compression or FIP inlet and compression outlet by Brass Craft or approved equal.

3.4 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.

3.5 ADJUSTING

A. Operate and adjust faucets. Replace damaged and malfunctioning fixtures and fittings.

B. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 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 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Mechanical sleeve seals.
2. Sleeves.
3. Escutcheons.
4. HVAC demolition.
5. Equipment installation requirements common to equipment sections.
6. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

1.5 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Panels."

D. Coordinate systems shutdown (water, fire protection, hot water heating, steam, chilled water, etc.) with MSU Project Manager/MSU Project Representative. Activation and shut down of existing systems shall be conducted by MSU personnel only.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Link-Seal.
b. Metraflex Co.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.4 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, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

D. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 for cutting and patching and Division 02 Section "Selective 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 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

B. Field Welding: Comply with AWS D1.1.

END OF SECTION 230500

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes testing, adjusting and balancing HVAC systems to provide design conditions as indicated by the associated drawings. This Section includes, but is not limited to the following:

1. Testing, adjusting and balancing of air flow rates at the system and distribution system level to the indicated quantities according to tolerances specified herein. The following systems to be included:

    a. Air Systems:

        1) Constant-volume air systems.
        2) Variable-air-volume systems.

2. Verification that automatic control devices are functioning properly.
3. Measurement of duct leakage.
4. Reporting results of the activities and procedures specified in this Section.

B. The testing, adjusting and balancing of the air system shall be performed by an independent TAB contractor contracted directly by the Owner.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. Adjust: To regulate air patterns at the system or terminal level. At the system level an example would be reducing fan speed; at the terminal level an example would be changing a damper position.

C. Balance: To proportion air flows within the distribution system, including submains, branches and terminals with respect to design quantities.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. Independent: Not affiliated with or in employment of any Contractor.

F. NEBB: National Environmental Balancing Bureau.

G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

K. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

L. TAB: Testing, adjusting, and balancing.

M. TABB: Testing, Adjusting, and Balancing Bureau.

N. TAB Specialist: An entity engaged to perform TAB Work.

O. Testing, Adjusting and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.

P. Terminal: A point where the controlled medium enters or leaves the distribution system.

1.4 INFORMATIONAL SUBMITTALS

A. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

B. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed and prior to commencing work, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

C. Certified TAB reports.

D. Sample report forms, other than those standard forms from AABC, NEBB or TABB.

E. List of instruments and associated calibration reports to be used on project; at a minimum, this shall include the following information:

1. Instrument type and make (manufacturer and model number).
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. Agent shall be an independent testing, adjusting and balancing professional services provider certified by AABC or NEBB and have a minimum of five years experience on projects of similar scope and complexity (unless waived by MSU Infrastructure Planning and Facilities / Planning, Design and Construction). Approved TAB Agent shall be considered from the following:

1. Absolut Balancing Company – South Lyon, MI.
2. Aerodynamics Inspecting Company – Dearborne, MI.
3. Air Flow Testing, Inc. – Lincoln Park, MI.
4. Enviro-Aire/Total Balance, Inc. – St. Clair Shores, MI.
5. Ener-Tech Testing, Holly, MI.
6. Hi-Tech Test and Balance – Freeland, MI.
7. International Test and Balance – Southfield, MI.
8. Mechanical Testing Services, Inc. – Grandville, MI.
9. Quality Air Service – Kalamazoo, MI.

B. TAB Conference: Meet with Commissioning Authority on approval of the TAB strategies and procedures plan. This will be carried out to develop a mutual understanding of the requirements for system configuration and scheduling. Require the participation of the TAB field supervisor, TAB technicians mechanical contractor, electrical contractor and controls contractor. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. 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.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Commissioning Authority.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

C. Systems shall be fully operational prior to system balancing. If a commissioning program is in place, all startup, testing and verification (STV) procedures shall be complete prior to initiation of TAB activities.

D. Construction Review: Provide onsite visit upon either completion of a commissioning program start-up phase or 100% controls completion and full system operability. Submit a “Systems Ready To TAB” checklist to Owner and CxA for completion by the appropriate installing contractors.

E. The mechanical contractor shall complete the installation and start all HVAC systems to ensure they are working properly, and shall perform all other items to assist the TAB contractor in performing the testing, adjusting, and balancing of the HVAC systems. Completion of a Systems Ready To TAB” checklist is required by the appropriate installing contractor prior to the beginning of TAB.

F. The mechanical contractor shall make any necessary changes to dampers as required by the TAB contractor at no additional cost to the owner.

G. The temperature control contractor shall complete the installation, and operate and test all control systems to ensure they are functioning properly as designed. The temperature control contractor shall assist the TAB contractor as needed to verify the operation and calibration of all temperature control systems. Completion of a Systems Ready To TAB” checklist is required by the appropriate installing contractor prior to the beginning of TAB.

H. Provide instruments and technicians as required to verify readings under direction of Owner.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TEST EQUIPMENT

A. Instrumentation shall be provided as necessary and appropriate to perform the work. The instrument shall be factory calibrated, and shall be used with the factory-determined application factors. When reasonable doubt of accuracy exists, recalibration of any or all instrumentation shall be performed as requested by the Commissioning Authority.

B. Make instruments available to Owner to facilitate TAB data verification during testing.

C. Test pressure taps, pressure gages, thermometers and wells shall be installed by the mechanical contractor as indicated or specified.

D. All manual volume dampers located above ceilings shall be outfitted with a ribbon of consistent color and type and installed by mechanical contractor for facilitation of locating dampers during TAB.

E. Any additional required pressure and flow taps, and thermometer wells in locations where permanent installation devices are not indicated or specified shall be provided by the mechanical contractor.

3.2 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 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 system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

F. Examine test reports specified in individual system and equipment Sections.

G. Examine existing HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

H. Examine terminal units, such as exhaust variable-air-volume valves, and verify that they are accessible and their controls are connected and functioning.

I. Report deficiencies discovered before and during performance of TAB procedures to Owner and CxA.. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Procedure shall include a project specific approach which integrates general methods as set forth by the AABC as per National Standards for Total System Balance and/or NEBB as per Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

C. Verify completion of the “Systems Ready to TAB” report. It shall include the following items:
1. Automatic temperature-control systems are operational.
2. Duct access doors are securely closed.
3. Fire dampers are open.
4. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
5. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 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, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

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, the mechanical contractor shall install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
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, 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.

3.5 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 as applicable. This plan shall be discussed and agreed upon with Owner and CxA. The final plan for diversity shall be reflected in the report by which it pertains.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check dampers for proper position to achieve desired airflow path.

F. Check for airflow blockages.

G. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 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 condition of filters.
4. Check the condition of coils.
5. Check the condition of dampers.
6. Verify appropriate location of balancing devices such that accurate measurements can be attained and final TAB can be completed.
7. Check the operation of the drain pan and condensate-drain trap.
8. Check bearings and other lubricated parts for proper lubrication.
9. 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. Dampers functioning properly.
6. Verify correct operation of existing measurement/balancing devices (eg, dampers, gauges, valves, etc.)

7. Bearings and other parts are properly lubricated.
8. 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.

3.7 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Air Outlets and Inlets: Plus or minus 10 percent.

3.8 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. Also, include system schematic diagrams consistently referenced with all equipment and test points, and preliminary test data.

B. Status Reports: Prepare monthly 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.

3.9 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Upon verification and approval of draft reports, submit 1 complete set of final reports certified by the TAB contractor for the Architect and 2 sets for inclusion in operating and maintenance manuals. Bind report forms complete with schematic diagrams and data in reinforced, vinyl, 3-ring binder manuals.

2. As-built system schematic diagrams consistently referenced with all equipment and test points, and final test data.
3. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
4. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Field test reports prepared by system and equipment installers.
2. 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. Data for terminal units, including manufacturer's name, type, size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for fans and pump performance forms including the following:

    a. Settings for exhaust-air dampers.
    b. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of supply and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Terminal units.
4. Position of balancing devices.

E. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. (sq. m).
g. Indicated air flow rate in cfm (L/s).
h. Indicated velocity in fpm (m/s).
i. Actual air flow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).
k. Barometric pressure in psig (Pa).
l. Percent of design achieved.

F. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary air flow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final air flow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in deg F (deg C).
h. Indicate final flow coefficient.
i. Percent of design achieved.

G. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Entering-water temperature in deg F (deg C).
c. Leaving-water temperature in deg F (deg C).
d. Water pressure drop in feet of head or psig (kPa).
e. Entering-air temperature in deg F (deg C).
f. Leaving-air temperature in deg F (deg C).
g. Terminal flow measuring device (circuit setter, flow meter, etc.) make/model/size.
h. Terminal flow measuring device water pressure drop (as required to determine terminal unit flow).
i. Final setting of flow measuring device valve handle indicator.
j. Percent of design achieved.

H. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.10 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
c. Verify that balancing devices are marked with final balance position.
d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.11 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Mineral fiber.

2. Fire-rated insulation systems.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Tapes.
8. Securements.

B. Related Sections:

1. Division 22 Section "Plumbing Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Qualification Data: For qualified Installer.

C. Field quality-control reports.

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation.

1.6 COORDINATION

A. Coordinate size and location of supports and hangers.

B. Coordinate clearance requirements with duct Installer for duct insulation application Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation for space required for maintenance.

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.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite FSK Duct-Wrap.
c. Owens Corning; All-Service Duct Wrap.

2.2 ADHESIVES

A. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials and substrates; comply with MIL-C-19565C, Type II.

2.4 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches (75 mm).
2. Thickness: 11.5 mils (0.29 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches (75 mm).
2. Thickness: 6.5 mils (0.16 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches (50 mm).
2. Thickness: 3.7 mils (0.093 mm).
3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.6 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

    a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

3. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 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. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 (50 mm) 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.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. 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. Handholes.
5. Cleanouts.

P. Continue insulation vapor barrier through penetrations except where prohibited by code. It is essential that the integrity of the vapor barrier is maintained. Fasteners or other securing devices that may unintentionally penetrate or otherwise damage the vapor barrier are prohibited. Where fasteners must penetrate the vapor barrier, the vapor barrier shall be repaired with a patch or tape of the same materials.

3.4 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. 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 (50 mm).

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. 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 (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 MINERAL-FIBER INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
5. 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.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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. 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. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply air.
2. Indoor, concealed exhaust air.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

B. Concealed, exhaust-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

END OF SECTION 230700

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

C. Owner will engage the Commissioning Authority under separate contract.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. AExA: Commissioning representative of the Architect/Engineer.

C. CxA: Commissioning Authority.

D. CxM: Commissioning Manager. The commissioning representative of the CM, appointed by the CM to manage and lead the commissioning effort on behalf of the CM.

E. CxR: Commissioning Representatives. Members of the Construction Manager's (CM) staff, contractor's, sub-contractors', manufacturers' and suppliers' staff, Owner's staff, Architect/Engineer's staff, or Owner's independent contractor assigned to participate in the commissioning process.

F. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

G. TAB: Testing, Adjusting and Balancing.

H. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Mechanical Contractor CxR shall submit approved equipment data sheets on systems to be commissioned to the CxA for review; these will include, but not limited to, the following:

1. Air handling units.
2. Fans.
3. Terminal units.
4. Sound attenuators.
5. Vibration isolation equipment.
6. Pumps.
7. Chillers.
8. Cooling towers.
9. Heat exchangers.
10. Balancing valves.
11. Coils.
12. Humidifiers.
13. Chemical treatment equipment/systems.
14. Snow melt equipment/systems.

G. Control Contractor CxR shall submit all approved equipment data sheets, approved control drawings and approved sequence of operations to the CxA.

H. TAB Contractor CxR shall submit certification documentation, TAB procedures plan, and preliminary project layout (which shall include an inventory of required flow rates for each air and hydronic system).

1.5 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.6 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Testing, adjusting, and balancing reports.
9. Laser alignment reports.
10. Vibration testing and analysis reports.
11. Completion report of pipe cleaning, flushing hydrostatic testing and chemical water treatment.

B. The CxA shall provide and include the following documentation:

1. Commissioning plan
2. Pre-installation checklists
3. Pre-startup verification checklists (installation and pre-startup phases)
4. Startup testing and verification checklists (startup phase)
5. Functional performance testing plan with procedures and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.
6. Final commissioning report

1.7 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.8 SYSTEMS TO BE COMMISSIONED

A. HVAC&R systems and associated control systems:

1. Air Handling Systems.
2. HVAC Zone Control Systems
3. Chilled Water Systems.
4. Steam and Condensate Systems.
5. Hot Water Heating Systems.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PRE-INSTALLATION VERIFICATION (PIV)

A. CxR for respective trade as indicated on PIV form will complete this scope of work; a sample PIV form for each equipment type has been included in Appendix 1 of this specification.

B. Review approved submittals for equipment included in systems to be commissioned.

C. Prior to the installation of each piece of equipment, verify that equipment arriving on site is consistent with that required.

D. The CxA shall carry out a 20% PIV sampling of each piece of equipment.

3.2 PRE-STARTUP VERIFICATION (PSV)

A. Prior to the installation of each piece of equipment, verify that equipment arriving on site is consistent with that required (ie, verify that the PIV for each piece of equipment has been completed and accepted)

B. CxR for respective trade as indicated on PSV form will complete this scope of work; a sample PSV form for each equipment type has been included in Appendix 1 of this specification.

C. Certify that HVAC&R systems, subsystems, and equipment have been installed according to the Contract Documents.

D. Certify that HVAC&R instrumentation and control systems have been installed, connected, calibrated and are ready for start-up procedures.

E. Inspect and verify the position of each device and interlock identified on checklists.

3.3 STARTUP TESTING AND VERIFICATION (STV)

A. Prior to the startup of each piece of equipment, verify that equipment installed is consistent with that required (ie, verify that the PSV for each piece of equipment has been completed and accepted)

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

D. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

E. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.4 TESTING, ADJUSTING AND BALANCING (TAB) VERIFICATION

A. Testing, adjusting and balancing shall be carried out in direct contract with the Owner.

B. Prior to performance of TAB Work, provide copy of completed system readiness checklists, preliminary report (comprehensive project layout in electronic format), and certification documentation to the CxA.

C. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

D. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

E. Vibration and Sound Tests: Upon completion of TAB Work, the Owner will provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls. Notify CxA at least 10 days prior to testing.

3.5 FUNCTIONAL PERFORMANCE TESTING REQUIREMENTS (FPT)

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Prior to the functional performance testing of each piece of equipment, verify that equipment has been correctly brought online and TAB report has been accepted (ie, verify that the STV for each piece of equipment has been completed and accepted)

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. All members of the Cx team shall provide technicians, instrumentation, and tools as required in the respective FPT test format (see Appendix 1 for CxR requirements) to perform commissioning test at the direction of the CxA.

E. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

F. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

G. The CxA along with the HVAC&R Subcontractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

H. Tests will be performed using design conditions whenever possible.

I. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

J. The CxA may direct that set points be altered when simulating conditions is not practical.

K. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

L. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

M. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.6 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 23 boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Section "Instrumentation and Control Devices for HVAC." Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 230800

SECTION 230913 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Control piping, tubing and wiring.
2. Pneumatic control devices.

1.3 SUBMITTALS

A. Shop Drawings: Include performance data, components and accessories, wiring diagrams, dimensions, weights and loadings, field connections, and required clearances.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For HVAC instrumentation and control system to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate location of thermostats with plans and room details before installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Honeywell.
2. Johnson Controls.
3. Siemens.

2.2 ELECTRICAL AND INTERLOCKS

A. Control Contractor shall furnish and mount electrical relays, switches, solenoids, transformers, etc., that are part of the control contract, and Electrical Contractor shall make the electrical interconnections. Electrical interconnections between controls and items of equipment shall be made by Electrical Contractor.

2.3 THERMOSTATS

A. Pneumatic Thermostats:

1. Wall mounted, pilot bleed, direct acting, proportional style with pneumatic feedback feature, 55 degree F to 85 degree F range, and an indicating thermometer.
2. Dual-Temperature Thermostats: Automatic changeover from normal setting to lower setting for unoccupied cycles, with manual-reset lever to permit return to normal temperatures during unoccupied cycles, with automatic reset to normal during next cycle of operation.
3. Limits: Field adjustable, to limit setting cooling set point below 75 deg F, and heating set point above 72 deg F.

2.4 AIR SUPPLY

A. Control and Instrumentation Tubing:

1. Hard drawn, type "L" copper tubing, ASTM B16, with solder joint fittings. Compression type fittings may be used for control device connections and shut-off valves only.
2. Polyethylene: Refer to “Pneumatic Piping Installation” for acceptable application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Verify location of thermostats with Drawings and room details before installation.

B. Control Devices:

1. All thermostats shall be field calibrated and verified.

3.2 PNEUMATIC PIPING INSTALLATION

A. Copper Tubing: Pipe shall be securely installed without dents and other imperfections, and it shall be capable of withstanding a rigid test against leakage. Piping shall be installed during the construction of the building, and it shall be protected from damage and placed in concealed positions where possible. Piping installed in plastered walls shall be recessed into the wall so that it will be covered by a full thickness of plaster. No plastic caps shall be allowed. Gauge taps, etc., shall use barbed plugs.

B. Polyethylene may be used as follows:

1. Exposed installations (Equipment Rooms, etc.): Single polyethylene tubing may be run exposed for lengths 18 inch or less. For lengths which exceed 18 inches, the lines shall be run within enclosed trough or conduit, and this tube carrier system shall be installed in a workmanlike manner, parallel to building lines, and adequately supported. All connections, except for terminal connection to valves, damper operators, etc., shall be made inside trough, junction boxes, or control cabinets. Exposed polyethylene tubing is acceptable only in control cabinets and, in a maximum 18" length, when connecting control devices which require a flexible connection to allow movement.
2. Factory manufactured bundles of polyethylene tubing, which are of the semi-rigid design with outer sheaths of aluminum and polyethylene, may be installed without additional trough or conduit envelope, provided that the bundled tube system is installed in the same workmanlike manner as specified for trough and conduit systems. Single or bundled tubing will not be allowed in concealed locations such as pipe chases, suspended ceilings, within walls, etc., unless run in conduit.
3. Concealed installations: Single polyethylene tubes and standard bundles of polyethylene tubing shall be run within enclosed trough or EMT conduit. Fitting connections shall not be made within an inaccessible area.

C. Number-code or color-code control air piping for future identification and service of control system, except local individual room control tubing.

D. Pressure Gages or Test Plugs: Install on branch lines at each receiver controller and on signal lines at each transmitter, except individual room controllers.

E. Extend pneumatic tubing systems as required for relocated thermostats.

3.3 FIELD QUALITY CONTROL

A. Provide field supervision, and calibration and start up service.

B. Upon completion of the work, the Contractor shall instruct the Owner's Operating Engineer and acquaint him with all of the operating characteristics of all equipment installed by him including the TCS and all other systems, at the same time operating each and every system individually for a period of two days, unless otherwise specified. During this two day period the building's Operations Manual shall be used for reference.

3.4 ADJUSTING

A. Calibrating and Adjusting:

1. Provide diagnostic and test instruments for calibration and adjustment of system.
2. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature set points.

END OF SECTION 230913

SECTION 230943 - PNEUMATIC CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes a functional pneumatic temperature control system.

B. The Temperature Control Contractor shall bid directly to and be contracted directly by the General Contractor or Construction Manager.

C. Related Sections include the following:

1. Division 23 Section "Instrumentation and Control Devices for HVAC".

1.3 SYSTEM DESCRIPTION

A. The Temperature Control System (TCS) work shall consist of, but not necessarily be limited to, room thermostats.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Details of control panel faces, including controls, instruments, and labeling.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For thermostats to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate location of thermostats with plans and room details before installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Honeywell.
2. Johnson Controls.
3. Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Special equipment shall be installed in accordance with manufacturer's instructions and recommendations. All control instruments shall be carefully adjusted and set for proper operating of the equipment served as noted herein or as required by the equipment manufacturer's instructions and recommendations.

B. Verify location of thermostats with Drawings and room details before installation. Extend pneumatic tubing systems as required for relocated thermostats.

3.2 FIELD QUALITY CONTROL

A. Provide field supervision, and calibration and start up service.

B. Upon completion of the work, the Contractor shall instruct the Owner's Operating Engineer and acquaint him with all of the operating characteristics of all equipment installed by him including the TCS and all other systems, at the same time operating each and every system individually for a period of two days, unless otherwise specified. During this two day period the building's Operations Manual shall be used for reference.

3.3 DEMONSTRATION

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

END OF SECTION 230943

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

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.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article unless otherwise indicated.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Standing seams T-15, angle reinforced standing seams T-16, welded flange T-21, reinforced welded flange T-21a, companion angles T-22, and formed-on flanges T-25a (TDC) and T-25b (TDF)
2. Use of drives slip seams on sides is acceptable for unreinforced ducts.
3. Use of tie rodded reinforcement alternative is not acceptable.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. All longitudinal seams on flat sides shall be of the grooved seam L-3.
2. All longitudinal corner seams shall be of the Pittsburgh lock L-1.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Smooth radius with at least one splitter vane and square throat R/W equal to 0.5 or higher.
2. Mitered and Tee-shape elbows with turning vanes are acceptable where space restrictions dictate.
3. Select 45 degree entry tees, conical or bell mouth tees, or wyes. Straight tap connections will not be accepted.

E. As an option, Ductmate proprietary duct connection systems may be used with permission of the Architect/Engineer. Refer to the manufacturer guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

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

    a. Lindab Inc.
    b. McGill AirFlow LLC.
    c. SEMCO Incorporated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
2. Lap at least 2 inches in direction of air flow and securely fastened with screws through the lap on center spacing not to exceed 2 ½ inches.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 (2286 mm) inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Elbows: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," unless otherwise indicated.

1. Smooth radius stamped elbows for 8" ducts and smaller. 5-piece segmented elbows for 9" duct and larger.
2. Elbows shall have a centerline radius at least equal to 1.0 times the duct diameter. Mitered elbow will not be accepted.

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: G90 (Z275).
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. 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.

E. Tie Rods: Galvanized steel, 1/4-inch (6 mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10 mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
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 (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel.

C. 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.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Hot-dipped galvanized steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

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 (25 mm), 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 (38 mm).

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 "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Use fabricated fittings for all changes in directions, sizes, shapes and connections.

N. Locate ducts parallel and perpendicular to building lines; avoid diagonal runs except as otherwise indicated.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 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."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing.

1. Install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
2. Install hangers at duct joints on either 8 or 10 foot centers, and at every change of direction.
3. Support ductwork directly from the building structure; not from the other ducts, piping, equipment, or roof deck.
4. Holes shall not be drilled or punched in beams and supporting members.

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 (5 m).

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.

3.5 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.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.

2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
3. Test for leaks before applying external insulation.
4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
5. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 DUCT CLEANING

A. Clean existing 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.

3.8 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: C.

C. Return Ducts:

1. Ducts Connected to existing exhaust fans:

a. Pressure Class: Positive or negative 3-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: B.

D. Transfer-Air Ducts:

1. Ducts Connected to Transfer Air Grilles:

a. Pressure Class: Positive or negative 1-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
1) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
c. Velocity 1500 fpm (7.6 mm) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers
2. Fire dampers
3. Flange connectors
4. Turning vanes
5. Duct-mounted access doors
6. Flexible connectors
7. Flexible ducts
8. Duct accessory hardware

1.3 SUBMITTALS

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

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

a. Special fittings
b. Manual volume damper installations
c. Fire-damper, installations, including sleeves; and duct-mounted access doors.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

C. Source quality-control reports.

D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

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: G90 (Z275)
2. Exposed-Surface Finish: Mill phosphatized

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), 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 (ASTM B 221M), 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 (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 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. Greenheck Fan Corporation
c. Louvers and Dampers; a division of Mestek, Inc.
d. McGill AirFlow LLC
e. Nailor Industries Inc.
f. Ruskin Company

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 (1.62 mm) 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 (1.62 mm) inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Oil-impregnated bronze or molded synthetic.
    b. Dampers in ducts with pressure classes of 3-inch (750 Pa) wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch (25 mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch (2.4 mm) thick zinc-plated steel, and a 3/4-inch (19 mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 FIRE DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Louvers and Dampers; a division of Mestek, Inc.
3. Greenheck Fan Corporation
4. McGill AirFlow LLC
5. Ruskin Company

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch (1 kPa) wg static pressure class and minimum 4000-fpm (20 m/s) velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch (0.85 mm) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034 (0.85 mm) inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Fusible links.

K. Round Fire Damper:

1. Rated for 2,000 fpm and 4 inches w.g.
2. UL 555 rated.
3. 20 gage integral galvanized steel sleeve with matching cinch plate.
4. 14 gage galvanized steel blades.
5. 1/2” diameter plated steel axle with stainless steel bearings pressed into frame.
6. 165 degree F fusible link.
7. Ruskin model FDR25 or approved equal.

2.4 FLANGE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.5 TURNING VANES

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

1. Ductmate Industries, Inc.
2. METALAIRE, Inc.
3. SEMCO Incorporated

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Double wall.

2.6 DUCT-MOUNTED ACCESS DOORS

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

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Ductmate Industries, Inc.
3. Flexmaster U.S.A., Inc.
4. Greenheck Fan Corporation
5. McGill AirFlow LLC
6. Nailor Industries Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "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. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
d. 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 (300 mm) Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.

2.7 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

A. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

2.8 FLEXIBLE DUCTS

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

1. Flexmaster U.S.A., Inc.; Type 8M
2. McGill AirFlow LLC

B. Acoustical, Insulated, Flexible Duct: UL 181, Class 1, CPE inner film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

2.9 DUCT ACCESSORY HARDWARE

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

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply and exhaust systems where branches extend from larger ducts.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.
3. Do not use extractors, splitter-type dampers, and register or diffuser dampers for volume control.
4. Locate volume dampers at least two diameters from a fitting and as far as possible from outlets.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes as indicated.

F. Install fire dampers according to UL listing.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. Downstream from manual volume dampers and equipment.
2. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
3. Control devices requiring inspection.
4. Upstream from flow measuring stations.
5. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).

J. Label access doors according to service access provided.

K. Install flexible connectors to connect ducts to equipment.

L. Connect diffusers to ducts with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

M. Connect flexible ducts to metal ducts with draw bands.

N. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Ceiling diffusers.
2. Registers and grilles.

B. Related Sections:

1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 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. Source quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Anemostat Products; a Mestek company.
2. Krueger.
3. Price Industries.
4. Titus.

2.2 GENERAL REQUIREMENTS

A. Air inlets and outlets shall be tested in accordance with ASHRAE 70.

B. Throw, horizontal distance from the diffuser to the point where the theoretical centerline velocity is 50 feet per minute, shall not exceed the horizontal distance between the diffuser and the nearest wall, or half the horizontal distance between ceiling diffusers.

2.3 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Style: Three cone.
5. Pattern: Adjustable.
6. Dampers: Not required.
7. Equal to Anemostat Model EPLA.

2.4 REGISTERS AND GRILLES

A. Supply Air Bar Grille:

1. Material: Steel.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: Adjustable. Vertical spaced 3/4 inch (19 mm) apart.
4. Rear Blade Arrangement: Adjustable. Horizontal spaced 3/4 inch (19 mm) apart.
5. Frame: 1-1/4 inches (32 mm) wide.
6. Mounting: Countersunk screw, concealed, or lay in as scheduled.

B. Return Air Bar Grille:

1. Material: Aluminum
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: 45 degree fixed horizontal spaced 3/4 inch (19 mm) apart.
4. Frame: 1-1/4 inches (32 mm) wide.
5. Mounting: Countersunk screw, concealed, or lay in as scheduled.

2.5 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 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 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 and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section shall apply to all Division 26 sections.

1.2 SUMMARY

A. Work Included

1. The work shall be executed in conformity with the drawings, the approved shop drawings, and these specifications.

2. In general, this work shall consist of, but not necessarily be limited to the following:

3. Demolition

4. New Work

B. Work Not Included

C. The Contractor shall refer to Alternates listed in Division 01 and Proposals and shall submit price quotations for the alternates that apply to the electrical work.

1.3 SUBMITTALS

A. Shop Drawings and Samples

1. The Contractor shall submit shop drawings for all major equipment including, but not limited to the following items and/or the items listed in Division 26 sections.

2. Quantity of shop drawings and information to be included shall be as specified in Division 01 - General Requirements.

B. As-Built Drawings

1. Quantity of shop drawings and information to be included shall be as specified in Division 01 - General Requirements.

2. The Contractor shall submit as-built drawings indicating the location of all outlets, junction boxes, and conduit runs; including conduit size, circuit numbers, and number of wires in each run.

C. Certificate of Electrical Inspection: Provide certificate as described in this section.

1.4 QUALITY ASSURANCE

A. Codes and Regulations

1. See Division 01 General Requirements for Codes and Regulations that apply.

2. The latest National Electrical Code shall be observed and shall govern the character of work, style, quantity and the size of all material used.

3. All materials shall conform with the standards of the Underwriter's Laboratories in every case where such standards have been established for the particular type of material in question.

4. All material and equipment shall be UL listed and bear the UL label where such listing and labeling exists.

5. The complete electrical installation shall comply with all the requirements of the MI.O.S.H.A.

6. Codes shall be used as minimum requirements, and where the Specifications or Plans call for an installation that exceeds and does not violate the Code requirements, the Specifications and Plans shall be followed.

B. Character of Work

1. The installation shall be executed in a workmanlike manner and shall present a neat mechanical appearance when completed.

2. Contractors working in the T.B. Simon Power Plant shall have a minimum of five years of experience working on like systems in power plants that involved in this project.

C. Permits and Inspections

1. The Electrical Contractor shall obtain and pay for all permits required by the State of Michigan Labor Department, Electrical Division.

2. The Electrical Contractor shall submit, to precede request for final payment, a copy of the Certificate of Electrical Inspection as required by the State of Michigan.

1.5 GUARANTEE

A. Refer to Division 01 - General Requirements.

B. Refer to individual Division 26 sections for any additional guarantee requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to individual Division 26 sections for product specifications.

B. Material to be Returned to the Owner

1. Refer to Division 01 - General Requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to Division 01 - General Requirements for items such as examination of premises, coordination with other trades, cutting and patching, connection to present equipment, etc.

B. Laying Out Work

1. All exterior light locations shall be staked out by the Contractor and approved by the Engineer prior to installation.

C. Equipment Supports

1. Enclosures for panelboards, motor starters, motor control centers, and other similar equipment shall be mounted on ½" spacers when mounted in a room on a below grade exterior wall.

D. Feeders and/or branch circuit wiring shall not pass through electrical equipment such as switchboards, panelboards, disconnect switches, and motor starter enclosures where the power source for that wiring originates in another location.

END OF SECTION 260500

SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the conductors and cabling for buildings and structures electrical systems under 600 volts. Wiring for fire alarm and communication systems is specified in their respective sections.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

B. Related Sections include the following:

1. Applicable sections of Division 26 - Electrical

1.3 SUBMITTALS

A. Tray cable.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code”

C. Furnish wire and cable that has been manufactured and factory tested in accordance with ASTM, ANSI, IPCEA, and NEMA.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. All wiring, branch circuits and feeders, 600 volts and below, shall be stranded copper, type THW, THWN, or THHN sized as indicated on the drawing. Aluminum conductors can be used for feeders above 150 amps.

B. Feeder phase identification from left to right or front to back facing front of equipment shall be one of the following:

Phase A	Phase B	Phase C	Neutral	System
X	Y	Z	N	Any voltage
BLACK	RED	BLUE	WHITE	120/208 volt feeders
BROWN	ORANGE	YELLOW	GRAY	277/480 volt feeders

C. In general, all branch circuit wiring shall be 600 volt type THHN or THWN, minimum wire size number 12 AWG, except where noted otherwise. Branch circuits 100 feet or longer shall be minimum size number 10 wire AWG.

D. 120 volt control circuits may be number 14 AWG wire.

E. Neutral conductor insulation color for emergency and “X” panel circuits shall be as noted above with a red tracer.

F. Cable types MC, MI, NM, NMC, or NMS shall not be used unless specifically noted on the drawings or in the specifications.

2.2 TRAY CABLE

A. Tray cable shall be three conductor with ground, size as shown on the drawings, UL listed TC for cable tray installation, and comprised of the following:

1. Class B stranded, tinned, annealed copper conductors, each insulated with flame-retardant ethylene propylene rubber (EPR) rated for 90 deg C operation. Each insulated conductor shall be individually identified by color coding to differentiate one phase from the other.

2. The three insulated conductors shall be cabled together with non-hygroscopic, flame-retardant fillers, a bare copper ground conductor with an overall binder tape applied.

3. A flame-retardant chlorinated polyethylene (CPE) jacket shall be applied over the cable assembly.

B. All new single conductor tray cable shall be covered with 3M Scotch 77 arc and fire proofing tape 2 inches wide. Apply two layers of tape, half lapped and wound in opposite directions

C. Cable shall be manufactured by General Cable, Kerite, or Okonite.

2.3 WIRING CONNECTIONS

A. Taps and splices in all feeder and branch circuit conductors larger than no. 8 AWG shall be made with approved solderless, pressure type bolted connectors. Splices in conductors no. 8 AWG and smaller may be made with preinsulated Scotchlock or Ideal Wing-Nut spring tension connectors.

B. Termination of motor leads to branch circuit conductors shall be made with Burndy Clear UNITAP inspectable insulated multiple tap connectors sized for the conductors being terminated.

PART 3 - EXECUTION

3.1 CONDUCTORS

A. All wiring shall be installed in rigid galvanized conduit, intermediate metal conduit (I.M.C.), flexible conduit, electrical metallic tubing (E.M.T.) or other approved raceway.

B. Pulling compounds shall be compatible with the cable being installed in accordance cable manufacturers recommendations.

C. A shared neutral between branch circuits shall not be used for single phase, phase-to-neutral loads at either 120 volts or 277 volts.

D. Neutral conductors in junction boxes, pull boxes, outlet boxes, etc. shall be identified with the associated phase conductor circuit number.

3.2 TRAY CABLE

A. In other than horizontal runs where side rails do not provide adequate containment of the cables, cable shall be fastened securely to transverse members of the tray.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the grounding and bonding of electrical systems for buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

B. Related Sections include the following:

1. Applicable sections of Division 26 – Electrical.

1.3 SUBMITTALS

A. Grounding test reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code.”

C. Comply with applicable requirements of U.L. Standards 467 pertaining to electrical grounding and bonding. Provide grounding products that are U.L. listed and labeled.

PART 2 - PRODUCTS

2.1 GROUND RODS

A. Ground bus shall be solid 98% conductivity, electrical grade copper.

2.2 CONDUCTORS USED FOR GROUNDING

A. Conductors used for grounding shall be stranded copper, THWN/THHN, the same as the feeder conductors and/or branch circuit conductors. Conductors buried in concrete shall have RHW or THW insulation.

B. Grounding conductors shall have green insulation the entire length. Isolated grounding conductors shall have green insulation with a yellow tracer the entire length.

PART 3 - EXECUTION

3.1 OTHER BUILDING SPACES

A. Install a 1/4 x 2 inch solid copper ground bus with predrilled holes where shown on the drawing. Length shall be 12” or longer as noted on the drawings. Connect each ground bus with a No. 4 AWG THWN/THHN grounding conductor in conduit to the ground grid in the main electrical room.

3.2 ISOLATED GROUNDING CONDUCTORS

A. Isolated grounding conductors shall be identified with its associated circuit at both ends and at all accessible points in the conduit/raceway system.

3.3 GROUNDING CONDUCTORS IN CONDUIT

A. A grounding conductor shall be installed in all conduits and raceways containing lighting and/or power circuits. Size the grounding conductor per the NEC for the associated circuit unless noted otherwise on the drawings.

END OF SECTION 260526

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the raceway, conduit, boxes, fittings, multioutlet assemblies, etc. for buildings and structures electrical systems.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

B. Related Sections include the following:

1. Applicable sections of Division 26 - Electrical

1.3 SUBMITTALS

A. Shop Drawings

1. Surface raceway.

2. Multioutlet assemblies.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code”

PART 2 - PRODUCTS

2.1 GENERAL INFORMATION

A. All boxes, brackets, bolts, clamps, etc., shall be galvanized, electro-galvanized, metalized, or sherardized.

B. All hardware used outdoors and in steam vaults shall be hot dipped galvanized.

C. Pull boxes, junctions boxes, and outlet boxes installed outdoors and in steam vaults shall be heavy duty die cast aluminum construction powder coat finished with gasketed cover plate.

2.2 CONDUIT

A. Rigid galvanized conduit shall be installed in poured concrete slabs, walls and partitions. Rigid or I.M.C. shall be installed in damp locations and inaccessible places.

B. All rigid conduit, I.M.C. and E.M.T. shall be hot dipped galvanized, sherardized, metalized or electro-galvanized.

C. In locations where rigid or IMC conduit cannot be turned and a fitting is required, three piece malleable iron/steel rain-tight fittings shall be used.

D. E.M.T. may only be installed exposed, above suspended ceilings, or in partitions.

E. Flexible metal conduit may be used for short runs, up to a length of six feet, to individual pieces of equipment.

F. Flexible metal conduit and flexible metallic tubing may be used for light fixture whips up to a length of six feet.

G. Liquidtight flexible metal conduit shall be used for short runs, up to a length of six feet, to individual pieces of equipment in mechanical rooms, penthouses, on roofs, water softener areas and other similar locations.

H. MC (metal clad) 2 conductor with ground cable can be used for lighting fixture whips.

I. MC (metal clad) whips with 2#12 conductors & #12 ground conductor and 2#16 conductors can be used for lighting fixture whips for LED lighting fixtures with low voltage dimming. Lighting fixture whips shall be AFC LW4H3S62E46-00 or approved equal.

J. All conduit 2-1/2 inches and larger shall be rigid or I.M.C.

K. No E.M.T. or aluminum conduit shall be used in concrete or direct burial, nor in water softener areas or similar corrosive locations.

L. Aluminum conduit may only be used in sizes 1-1/2 inch and larger. No aluminum conduit will be permitted in concrete. When aluminum conduit is used, all bends shall be galvanized steel.

M. Size and type of conduit shall comply with the National Electric Code. Where conduits are indicated on the drawing to be larger than required by Code, the larger conduit shall be used.

N. All conduit used for life safety systems such as emergency lighting, shall have a green topcoat to identify as life safety.

O. Minimum conduit size shall be 3/4 inch for all feeder and branch circuit conduits to all panels, junction boxes, pull boxes, and outlets.

P. Short runs of exposed conduit to individual pieces of equipment may be one-half inch.

Q. Minimum conduit size shall be one-half inch for low-voltage control wiring.

R. Where metal conduit is buried underground outside the building walls, to signs, exterior lights, etc., it shall be not less than 1 inch regardless of wire size.

2.3 PULL AND JUNCTION BOXES

A. All pull boxes shall be galvanized sheet steel, sized as required, with thickness not less than no. 14 gauge.

B. All pull and junction boxes used for fire alarm system wiring shall have a red cover plate.

2.4 OUTLET BOXES

A. All outlets, except as otherwise specified, shall consist of approved galvanized steel boxes of pattern adapted to the special requirements of each outlet, securely fastened in place in an approved manner.

PART 3 - EXECUTION

3.1 CONDUIT

A. Conduit shall be concealed in all new walls and run above suspended ceilings.

B. Channel existing plaster walls and/or ceilings to conceal conduit in finished areas.

C. In lieu of channeling existing plaster walls and where lay-in ceilings are used, flexible metal conduit of minimum size 3/4" may be installed from a switch or receptacle outlet up to a junction box located above the lay-in ceiling. In this instance, the conduit length may exceed six feet.

D. Use Wiremold where necessary to run exposed on existing walls and/or ceilings in finished areas as shown on the drawings.

E. Use Wiremold where necessary to run exposed on existing walls and/or ceilings in finished areas.

F. Provide one spare 1 inch conduit up and one down, to ceiling space, from each new flush panel.

G. All conduits shall be fastened or suspended from structural members, slabs, or walls only. It shall not be run on or fastened to tee bars of suspended lay-in ceilings.

H. All conduits shall be supported by approved hangers.

I. Conduit shall be terminated with locknuts and bushings in all outlet boxes and panels. Insulated bushings shall be used on all rigid conduits 1-1/4 inch and larger. Use insulated bushings and connectors on all E.M.T. All conduit connectors and couplings shall be galvanized steel; cast connectors and couplings are not acceptable.

J. Threaded couplings, connectors, and conduit bodies shall be used on rigid galvanized conduit and intermediate metal conduit; set screw or threadless types are not acceptable.

K. All exposed conduits shall be run parallel to the structural members of the building in a neat manner, securely fastened in place. Approved conduit type fittings or outlet boxes shall be used at all bends in a vertical plane or where breaking around beams or columns. Bends on ceilings in a horizontal plane shall be made with long sweep ells. Paint all exposed conduit in finished areas to match existing finishes.

L. All conduits penetrating underground walls into basements, crawlspaces, vaults, etc. shall be sealed between the conduits and walls with Link-Seal Model “C” modular sealing system.

M. When metal conduit extends below the bottom of a slab on the ground, the slab shall be thickened in the area of the conduit so as to encase the conduit in concrete by at least 2 inches on all sides. The responsibility for and expense of this work shall be borne by the Contractor.

N. Where high voltage conduit or fiber duct is laid beneath the floor slab of a building, there shall be a minimum of 6 inches of sand fill between the outside of the concrete envelope around the conduit and the underside of the floor slab.

3.2 PULL AND JUNCTION BOXES

A. Pull boxes shall not be installed in inaccessible locations.

B. In general, pull or junction boxes shall be used in conduit runs when the number of bends in the conduit run exceeds 360 degrees. When conduits are installed in a bank, conduit bodies may be utilized due to space limitations.

3.3 MOUNTING UNDER ROOF DECKS

A. Conduit and raceways systems shall not be mounted directly to the underside of roof decks or installed through the webbing, flutes, or ribs of the roof deck support system.

B. Conduit and raceway systems shall be attached to the bottom of the structural elements supporting the roof deck.

END OF SECTION 260533

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the identification for electrical equipment in buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

B. Related Sections include the following:

1. Applicable sections of Division 26 - Electrical

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 NAMEPLATES

A. Nameplates shall be provided on all major equipment, including the following:

Primary Switches	Contactors
Substations	Remote Controlled Switches
Drawout Circuit Breakers	Dimmers
Disconnect Switches	Control Devices
Switchboards	Transformers
Panelboards, electrical cabinets, enclosures	Adjustable Frequency Drives
Motor Starters	Power Generating Units
Motor Control Centers	Fire Alarm Control Panel
Push Button Stations	Etc.

B. Nameplates shall be plastic laminate, white face with black engraved letters, numbers, etc.

C. All junction box and pull box covers shall be labeled with the circuit numbers of the circuits contained in the boxes using laminated labeling such as TZ Tape.

END OF SECTION 260553

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes commissioning process requirements for electrical systems, assemblies, and equipment.

B. Related Sections:

1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

C. Start up of equipment and systems such as medium voltage switches, transformers, unit substations, emergency power and lighting systems, etc. shall be done by or with a trained manufacturer's representative who can check and report on all items such as installation, operation, and see that the equipment or system starts and operates properly.

D. Testing shall be performed at the convenience of the Owner and with the Owner’s representatives present and the manufacturer’s representative of the equipment and/or system present.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

1.5 UNIT PRICES

A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Division 01 Section "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in electrical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.7 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual electrical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing and adjusting of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.8 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for electrical systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.

5. Certificate of readiness certifying that electrical systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing and adjusting reports.

1.9 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing and adjusting procedures have been completed and that testing and adjusting reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING VERIFICATION

A. Prior to performance of testing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing Work, and provide access for the CxA to witness testing Work.

C. Provide technicians, instrumentation, and tools to verify testing of electrical systems at the direction of the CxA.

1. The CxA will notify testing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.

2. The testing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing and adjusting report.

4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of electrical testing shall include all components, equipment, and systems as outlined in outlined later in this section.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response to input signals.

D. The CxA along with the Electrical Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

3.4 MEDIUM-VOLTAGE CABLE

A. High potential and megger tests shall be made of the completed circuit and the high potential test results plotted.

B. The high potential tests shall be made in accordance with current industry standards. The test voltages, voltage increments, and time intervals shall be as follows:

1. Installation test
   30 kV test voltage
   3 kV step increase from 0 to 30 kV
   15 minutes 1t 22.5 kV

2. Maintenance proof test
   22.5 kV test voltage
   3 kV step increase from 0 to 22.5 kV
   5 minutes at 22.5 kV

3.5 PRIMARY SWITCH UNITS

A. Primary switch units and automatic throwover devices shall be operated in all modes to ensure proper operation.

3.6 TRANSFORMERS

A. Transformers shall be tested in accordance with the latest ANSI C57.12.90 Standard.

3.7 DRAW-OUT CIRCUIT BREAKERS

A. All draw-out circuit breakers shall be tested and set using the proper instruments for this operation.

3.8 VARIABLE FREQUENCY DRIVES

A. All variable frequency drives shall be tested, connected in its final location to the building power system, under 100% motor load for compliance with the frequency and notch requirements specified under the Variable Frequency Drive section of the specification. The Contractor shall add any necessary filtering to the drive(s) to meet the specification.

3.9 LIGHTING DIMMING AND CONTROL SYSTEMS

A. All dimming systems shall be operated throughout its entire range with all functions operated to verify proper operation.

B. All occupancy sensors shall be tested for proper operation over the entire intended zone of coverage.

END OF SECTION 260800

SECTION 260923 – LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the dimming control and occupancy sensors for lighting systems as shown and the drawing and specified herein for buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

3. The Contractor shall furnish and install a complete dimming control system and occupancy sensor system, as shown on the drawing and specified herein.

B. Related Sections include the following:

1. Applicable sections of Division 26 – Electrical

1.3 SUBMITTALS

A. Shop Drawings:

1. Dimming control systems
2. Occupancy sensors

B. Operation and Maintenance Data:

1. Dimming control systems
2. Occupancy sensors

1.4 QUALITY ASSURANCE

A. Wall box dimmers, occupancy sensors, and dimming systems shall comply with all applicable Underwriters Laboratory and ANSI/IEEE Standards.

B. Dimming systems:

1. Equipment shall be fully tested for proper operation prior to shipment from the factory.

PART 2 - PRODUCTS

2.1 OCCUPANCY SENSORS

A. Wall box occupancy sensors for small offices, storage rooms, copy rooms, etc. shall be:

1. Lutron MSA102 (single relay) for single level lighting and MSA202 (dual relay) for two level lighting

2. Wattstopper DW-100 (single relay) for single level lighting and DW-200 (dual relay) for two level lighting.

3. Hubbell Building Automation LHMTS (single relay) for single level lighting and LHMTD (dual relay) for two level lighting.

B. Wall box occupancy sensor/dimmer for small offices and personal care restrooms shall be:

1. Lutron MS-Z-101W.

2. Legrand DW-311-W.

C. Ceiling mount occupancy sensors for large offices and conference rooms shall be:

1. Leviton OSW/OSC sensor and a OPP20-OD2 power pack.

D. The lighting controls for wallbox occupancy sensor/switch and ceiling mounted occupancy sensors with power packs are shown in the lighting control details. See the MSU construction standards website for these details to be used on campus. See 3.1.G. for a listing of the interior lighting details

2.2 WALLBOX DIMMERS

A. Wall box dimmers shall be U.L. listed for the required lighting load and shall be capable of operating at full capacity with no adverse effect to the dimmer.

B. Dimmers shall incorporate power failure memory. Should power be interrupted and subsequently restored, the lights will come on to the level they were set at prior to the power interruption.

C. Dimmers shall be equipped with RFI filters.

D. Dimmer faceplate shall snap on the device with no visible means of attachment. At locations with multiple dimmers, one seamless, multigang faceplate shall be provided. Faceplate finish shall be Ivory.

E. LED Dimmers

1. LED wall box dimmers shall be Lutron DVSTV-WH for use with 0-10V LED drivers.

2. LED wall box dimmers shall be Leviton IP-710-LFZ-WH for use with 0-10V LED drivers.

2.3 SYSTEM DIMMERS

A. Dimming Panels

1. Panels shall also contain branch circuit breakers for individual channels. Circuit breakers shall be U.L. listed under U.L. 489. Branch breakers shall be thermal-magnetic type. Breakers shall have a minimum interrupting rating of 10,000 amps.

2. Panels shall be cooled via free-convection, unaided by fans.

3. Dimmer modules shall respond to control signals following the Square Law dimming curve as published by the IES.

4. Dimmer shall have an integral inductive toroidal filter to limit objectionable harmonics, reduce acoustical noise in incandescent lamps, and limit conducted radio frequency interference on the dimmer panel feed and branch circuits.

5. A positive air gap relay shall be employed with each module to ensure that the load circuits are open when the OFF function is selected at a control station.

6. Panels shall have a minimum of six modules and be expandable up to twelve modules either within one panel or by adding additional panels (controlled thru the first panel).

B. Main Control Panels

1. Main control shall have individual controls each module and master control to control all modules simultaneously.

C. Accessory Controls

1. Accessory controls shall have one or some combination of the following functions as indicated on the drawings:

   a. Master ON – OFF
   b. Individual channel ON - OFF and dim control
   c. Master dim control for dimmed modules in that room

D. Manufacturers

1. Systems shall be Strand “Microcontrol Station” system using Digital Environ cabinet.

2.4 DAYLIGHT HARVESTING

A. Continuous, closed loop, 0-10v dimming shall be used for all LED lighting fixtures on campus.

B. Daylight sensors for continuous dimming shall be Watt Stopper LS-301 with LSR-301-S power pack.

C. Daylight sensors for step dimming shall be Watt Stopper LS-102 with BZ-50 power pack.

D. Daylight sensors shall be calibrated as follows:

1. Continuous dimming in areas of 40-50 foot candle = 65 – 110 foot candle approx. range

2. Continuous dimming in areas of 15 foot candle = 25 – 40 foot candle approx. range

2.5 ROOM CONTROLLERS

A. Room controllers shall be used for daylight harvesting, 50% auto on/auto off exception, dimming and switching.

B. The control wiring shall be hard wired, not wireless.

C. Room controllers shall be:

1. Eaton Greengate RC3DE with OAT-DT occupancy sensors, DSRC-FM0112 daylight sensors and LMDM wall switches and other options as required or equal. This room controller is used for classrooms on campus, with consistent switching/dimming and standard engravings including the "Off" selection for dimming which has been requested by the campus instructors. The complete part number is shown on the detail which will provide the engravings as needed.

2. Wattstopper LMRC-213 with LMDC occupancy sensors and LMDM wall switches and options as required or equal. This room controller is used for conference and meeting rooms with consistent switching/dimming and standard engravings. The complete part number is shown on the detail which will provide the engravings as needed.

D. The lighting controls for room controller ceiling mounted occupancy sensors are shown in the lighting control details. See the MSU construction standards website for these details to be used on campus. See 3.1.G. for a listing of the interior lighting details.

PART 3 - EXECUTION

3.1 OCCUPANCY & DAYLIGHT SENSORS, DIMMERS AND ROOM CONTROLLERS

A. When occupancy sensor power packs are used they shall be mounted above the ceiling adjacent to one of the sensors and wired to the sensors with minimum 18 AWG multi-conductor low-voltage cable. In hard ceilings install an access panel having the same rating as the ceiling to access the power pack. Install low-voltage cable per NEC.

B. All control circuits – individual conductors or cables – shall be installed in conduit, basket or ladder style cable tray, or J-hooks. J-hooks to be spaced at 36" maximum intervals with a cable sag of less than 6". Closer spacing may be necessary when cables are routed around corners or in close proximity to other mechanical and electrical systems. J-hooks to be 2" Doc Industries JH32 or equal.

C. Ceiling mount occupancy sensors shall be installed at approx. 70% of the rated distance to ensure adequate coverage on campus. The occupancy sensor rated distances shall be the following:
1. Wattstopper DT-200/DT300 ceiling mounted occupancy sensor adjusted distance = 25'.
2. Leviton OSW/OSC ceiling mounted occupancy sensor adjusted distance = 25'.
3. Wattstopper LMDX/LMDC ceiling mounted occupany sensor adjusted distance = 20'.
4. Greengate OAWC/OAC ceiling mounted occupancy sensor adjusted distance = 20'.

D. Install occupancy sensor power packs above a lay-in ceiling close to the lighting switch. If there is a plaster ceiling or metal spline ceiling system, install the power pack as close as possible to the lighting switch.

E. Contractor shall furnish and install all equipment, labor, system setup, and other services necessary for the proper installation of the devices as indicated on the drawings and specified herein. System setup shall include defining each dimmers load type, assigning each load to a module, and setting the functions of the controls.

F. The following table describes the intended occupancy control for the various areas on campus.

SPACE TYPE	9.4.1.1.|b| RESTRICTED TO MANUAL ON	9.4.1.1.|b| EXCEPTION OF 50% AUTO ON	100% AUTO ON	100% AUTO ON PDC SAFETY AND SECURITY EXCEPTION	9.4.1.1.|d| BI-LEVEL CONTROL
1. AUDIENCE SEATING AREA - ALL TYPES, NOTE 1	NO	YES			YES
2. CLASSROOM/LECTURE HALL/TRAINING ROOM, NOTE 2	NO	YES			YES
3. CONFERENCE/MEETING/MULTPURPOSE ROOM, NOTE 2	NO	YES			YES
4. COPY/PRINT ROOM	YES				YES
5. CORRIDOR, NOTE 3	NOT REQD		YES		NOT REQD
6. COMPUTER ROOM	AUTO ON SAFETY		YES	YES	YES
7. RESEARCH OR CLASSROOM LAB, NOTE 4	NOT REQD		YES	YES	YES
8. LOBBY, NOTE 2	NO	YES			YES
9. LOCKER ROOM	AUTO ON SAFETY		YES	YES	YES
10. OPEN OFFICE, NOTE 2	NO	YES			YES
11. ENCLOSED OFFICES	YES				YES
12. RESTROOMS	NOT REQD		YES		NOT REQD
13. STAIRWELLS, NOTE 3	NOT REQD		YES		YES
14. STORAGE ROOMS	YES				NOT REQD
15. OTHER AREAS ON CAMPUS NOT LISTED, NOTE 7					

9.4.1.1.|a| LOCAL CONTROL	See Design GL
9.4.1.1.|c| RESTRICTED TO PARTIAL ON	Not used
9.4.1.1.|g| AUTO PARTIAL OFF	NOTE 5
9.4.1.1.|h| AUTO FULL OFF	NOTE 5
9.4.1.1.|I| SCHEDULED SHUT OFF	NOTE 6

NOTES:
1. LARGE AUDITORIUMS WILL HAVE A LIGHTING CONTROL SYSTEM OR BAS.
2. ROOM CONTROLLERS TO PROVIDE 50% AUTO ON LOGIC.
3. NL LIGHTS TO PROVIDE 1FC MIN IN UN-OCCUPIED STATE. SEE MBC 2015
4. INSTALL OCCUP SENSORS IN LABS.
5. AUTO FULL OFF IS USED IN PLACE OF PARTIAL OFF.
6. OCCUP SENSOR SIGNAL IS USED IN PLACE OF TIME OF DAY SHUTOFF.
7. VERIFY LIGHTING OPERATION WITH ATHLETICS, RHS OR OTHER AREAS.

G. The following index is the listing of the interior lighting details to be used at MSU.

DETAIL NO	MSU ROOM	APPLICATIONS	EQMT	DIM	EMG	CONTROL ACTION
1	3	COPY/SUPPLY ROOM	WALLBOX OS			MANUAL ON/AUTO OFF
2A	6B,12A	I.T. CLOSET/SMALL RESTROOM	WALLBOX OS		X	AUTO ON/AUTO OFF
2B	13	PERSONAL CARE RESTROOM	WALLBOX OS	X	X	AUTO ON/AUTO OFF
3A	11A	SMALL OFFICE	WALLBOX OS	X		MANUAL ON/AUTO OFF
3B	11A	SMALL OFFICE WITH TLED	WALLBOX OS - 2 ZONE			MANUAL ON/AUTO OFF
4	9,12B	LOCKER ROOM/LARGE RESTROOM	CEILING OS - 1 ZONE		X	AUTO ON/AUTO OFF
5	6A,7A	I.T. ROOM & LAB WITH HAZARDOUS MATERIALS	CEILING OS - 3+ ZONES		X	AUTO ON/AUTO OFF
6	4	CORRIDOR/STAIRWELL	CEILING OS - 1 ZONE		X	AUTO ON/AUTO OFF
7	5	PASSAGEWAYS	CEILING OS - 1 ZONE		X	AUTO ON/AUTO OFF
8	11B,14	LARGE OFFICE /MEETING ROOM	CEILING OS - 1 ZONE	X		MANUAL ON/AUTO OFF
8A	11B,14	DETAIL 8 WITH EMG BATTERY	CEILING OS - 1 ZONE	X	X	
8B	11B,14	DETAIL 8 WITH EMG GENERATOR	CEILING OS - 1 ZONE	X	X	
9	1,2A,7B	CONF/MULTI/CLASSROOM/LAB W/OUT HAZARD. MTL.	CEILING OS - 2 ZONES	X		MAN. ON/AUTO OFF WITH
9A	1,2A,7B	DETAIL 9 WITH EMG BATTERY	CEILING OS - 2 ZONES	X	X	50% AUTO ON EXCEPTION
9B	1,2A,7B	DETAIL 9 WITH EMG GENERATOR	CEILING OS - 2 ZONES	X	X	
10A	1,8,10	CONF/MULTI/LOBBY/OPEN OFFICE - EMG BATTERY	RM CNTL - 3+ ZONES	X	X	MAN. ON/AUTO OFF WITH
10B	1,8,10	CONF/MULTI/LOBBY/OPEN OFFICE - EMG GENERATOR	RM CNTL - 3+ ZONES	X	X	50% AUTO ON EXCEPTION
11A	2B	CLASSROOM/LECTURE HALL - EMG BATTERY	RM CNTL - 3+ ZONES	X	X	MAN. ON/AUTO OFF WITH
11B	2B	CLASSROOM/LECTURE HALL - EMG GENERATOR	RM CNTL - 3+ ZONES	X	X	50% AUTO ON EXCEPTION

MSU ROOM TYPES

1. CONFERENCE/MULTIPURPOSE	8. LOBBY
2A. CLASSROOM - 2 ZONE	9. LOCKER ROOM
2B. CLASSROOM/LECTURE HALL - 3 ZONE	10. OPEN OFFICE
3. COPY/SUPPLY	11A. SMALL OFFICE <=120 SF
4. CORRIDOR/STAIRWELL	11B. LARGE OFFICE > 120 SF
5. PASSAGEWAY IN OPEN OFFICE/SUITE	12A. SMALL RESTROOM - SINGLE
6A. I.T. ROOM	12B. LARGE RESTROOM
6B. I.T. CLOSET	13. PERSONAL CARE ROOM
7A. LABS - WITH HAZARDOUS MATERIALS	14. MEETING ROOM
7B. LABS - WITHOUT HAZARDOUS MATERIALS	

END OF SECTION 260923

SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the wiring devices for buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

B. Related Sections include the following:

1. Applicable sections of Division 26 - Electrical

1.3 SUBMITTALS

A. Shop Drawings:

1. Switches
2. Receptacles
3. Receptacle and switch cover plates
4. Floor boxes and all associated fittings and components
5. Relays
6. Time switches

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code”

PART 2 - PRODUCTS

2.1 SWITCHES

A. Switches, single, 2 pole, 3 way, 4 way and key type, shall be lifetime quite type, Cooper 2200 series, Hubbell HBL1200 series, Leviton 1200 series, or equal P. and S., color brown.

B. Switch and pilot light combination shall consist of switch, Cooper 2200 series, and a flush neon pilot light, 125 volt with red plastic jewel, Cooper 277 or Leviton catalog no. 5336.

C. Switch and pilot light combination shall be Leviton catalog no. 5226, 15A., 120 VAC single pole switch and 1/25W, 125V. neon pilot light, red jewel face.

D. Presswitch single, 2 pole, 3 and 4 way, shall be Hubbell 1200 series, color brown.

E. Three position, two circuit, momentary contact switches shall be such as Hubbell catalog no. 1556, 15A., 120-277V. color brown or equal Cooper, Leviton, or P. and S.

2.2 RECEPTACLES

A. In general, duplex receptacles shall be 20 ampere, 125 volt, 3 wire, grounding type, heavy duty, specification grade, color brown. Receptacles shall be:

1. Cooper 5362
2. Hubbell HBL5362
3. Leviton 5362
4. Pass and Seymour 5362A

B. 15 ampere, 125 volt, 3 wire grounding type duplex receptacles shall be heavy duty, specification grade, color brown. Receptacles shall be:

1. Cooper 5262
2. Hubbell HBL5262
3. Leviton 5262
4. Pass and Seymour 5262A

C. Ground fault circuit interrupter receptacles shall be self-testing, industrial specification grade, extra-heavy duty, 20 ampere, 125 volt, with feed through, pilot light, color brown. GFCI receptacles shall be:
1. Leviton GFPL2-PL

D. 15 ampere, 125 volt, 3 wire duplex receptacles with isolated ground, shall be Hubbell catalog no. IG-5262, Leviton catalog no. 5262-IG, Cooper catalog no. IF5262, or equal P. & S.

E. 15 ampere, 125 volt, 3 wire, grounding type with transient voltage surge suppressor for computer outlets, shall be Leviton catalog no. 5280.

F. 20 ampere, 250 volt, 3 wire twist-lock receptacle, shall be Hubbell catalog no. 2320, Leviton catalog no. 2320, or equal Cooper or P. & S.

G. 30 ampere, 125 volt, 2 pole, 3 wire receptacle shall be such as Hubbell catalog no. HBL9308, Leviton catalog no. 5371, or equal Cooper or P. & S.

H. 30 ampere, 125 volt, 2 pole, 3 wire twist-lock receptacle with isolated ground, shall be Hubbell catalog no. IG-2610, Leviton catalog no. 2610-IG, or equal Cooper or P. & S.

I. 30 ampere, 250 volt, 2 pole, 3 wire receptacle shall be such as Hubbell catalog no. HBL9330, Leviton catalog no. 5372, or equal Cooper or P. & S.

J. 30 ampere, 250 volt, 2 pole, 3 wire twist-lock receptacle, shall be Hubbell catalog no. 2620, Leviton catalog no. 2620, or equal Cooper or P. & S.

K. 15 ampere, 250 volt, 3 wire grounding type, single receptacle for window a.c. unit shall be Hubbell catalog no. 5652 or Leviton catalog no. 5661.

L. 20 ampere, 250 volt, 3 wire, single receptacle for window a.c. unit shall be Hubbell catalog no. 5461 or Leviton catalog no. 5461.

M. 20 ampere, 250 volt, 2 pole, 3 wire, single phase, duplex receptacle shall be Hubbell catalog no. 5462 or Leviton catalog no. 5462.

N. 20 ampere, 125/250 volt, 3 pole, 4 wire grounding, single phase receptacle shall be Hubbell catalog no. HBL8410.

O. 20 ampere, 250 volt, 3 pole, 4 wire grounding, 3 phase single receptacle shall be Hubbell catalog no. HBL8420.

P. Floor receptacles shall be Walker 500 AL series, G.E. Co. SP-400RG, or National no. 7903-LGC.

Q. Clock outlets shall be Leviton catalog no. 5261-CH. Clock outlets to be mounted 6 inches to center below suspended ceiling or 7 feet above the floor in rooms without suspended ceiling.

2.3 COVER PLATES

A. Switch and receptacle plates shall be stainless steel, non-magnetic type 302, such as Hubbell 97000 series, except where specified otherwise.

B. Switch and receptacle plates in corrosion areas such as chemical laboratories shall be Leviton unbreakable nylon, color brown.

C. Switch and receptacle plates shall be brown bakelite, such as Hubbell 91000 series, Leviton 84000 series, or approved equal.

D. Weatherproof receptacle rain tight while in use covers shall be Hubbell WP826 series, Leviton 5970 or 5990 series, or equal Cooper or P. & S.

E. Weatherproof switch plates shall be Hubbell catalog no. 1750 gray hypalon presswitch plate.

F. Weatherproof switch plates shall be Hubbell catalog no. 1785 gray hypalon presswitch plate with 125V. red pilot light.

2.4 FLOOR BOXES

A. Floor box shall be Steel City Series 600 cast iron box with P60-DS bronze floor plate assembly and P60-CP bronze carpet plate (use when floor finish is carpet).

2.5 SPECIAL CONTROLS

A. As specified, special controls shall be furnished by the contractor furnishing the associated equipment. These controls shall be connected by the electrical contractor.

B. Refer to Mechanical Specifications.

2.6 TIME SWITCHES

A. Connect time clock controlling supply, exhaust, and recirculating air fans as specified in the Mechanical Sections. Time clocks to be furnished by Mechanical Contractor.

B. Time switches for window mounted air conditioners shall be Intermatic FF4H, SPST, 20A, 120V, brushed nickel dial with 4 hour timer. This 120V timer is used with a contactor having 120V control voltage for 120V and 208V air conditioners.

C. Time switches to control individual room lights shall be Intermatic catalog no. T101, SPST, 125 volt, 40 amp., or approved equal.

2.7 RELAYS

A. Multiple pole relays shall be Square D Class 8501, Type X, 600 volt, 10 ampere, or approved equal, Westinghouse, General Electric, Challenger, Cutler-Hammer, or Siemens number of poles and type of enclosure as noted on drawing.

2.8 EMERGENCY-OFF STATION

A. Emergency-off station to control contactor panel shall be such as Square D, Class 9001, Type K-15 break-glass operator with KA-2 N/O contact block, K-25 stainless steel plate, flush mounting, and KN-299 EMERGENCY-OFF legend plate.

B. Emergency-off station to control contactor panel and air conditioning system shall be such as Square D, Class 9001, Type K-15 break-glass operator with 2 KA-2 N/O contact blocks, K-25 stainless steel plate flush mounting, and KN-299 EMERGENCY-OFF legend plate.

PART 3 - EXECUTION

3.1 SWITCHES

A. Switches, unless otherwise noted, shall be mounted 48 inches to center above finished floor.

3.2 RECEPTACLES

A. Receptacle outlets, unless otherwise noted, shall be mounted 18 inches to center above finished floor.

END OF SECTION 262726

SECTION 262813 – FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. This Section specifies the fuses for buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein for a complete operating system.

B. Related Sections:

1. Applicable sections of Division 26 - Electrical

1.3 SUBMITTALS

A. Shop Drawings

1. Low-voltage fuses.

PART 2 - PRODUCTS

2.1 FUSES

A. Fuses where required and/or specified for electrical equipment shall be Bussmann Fusetrons or equal by Littelfuse.

B. Where fused disconnect switches are used protect for wire protection fuses shall be sized to protect the wire and be furnished for the disconnect switches.

C. Fuses sized for motor protection shall be furnished for all combination starters. (Not greater than 125% of motor nameplate rating.)

D. Fuses sized as shown on drawings shall be installed in all non-motor starter switches of motor control centers.

PART 3 - EXECUTION

Not used.

END OF SECTION 262813

SECTION 265100 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the interior light fixtures for buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

3. The Contractor shall furnish and install all light fixtures, as shown on the drawing. Light fixtures shall conform to the types and manufacturers as hereinafter specified.

4. The Contractor shall furnish all lamps and necessary hangers, supports, wiring, etc., for installation of light fixtures.

B. Related Sections include the following:

1. Applicable sections of Division 26 – Electrical

1.3 SUBMITTALS

A. Shop Drawings:

1. Light fixtures

1.4 QUALITY ASSURANCE

A. Light fixtures: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code”

1.5 DESIGN REQUIREMENTS

A. Light fixtures and lenses must comply with School Fire Safety Regulations adopted January 3, 1973. Certification shall accompany shop drawing submittal.

PART 2 - PRODUCTS

2.1 LENSES

A. Lenses shall be flat, 0.125 inch thick, 100% virgin acrylic plastic, clear, with a prismatic pattern, and mounted in hinged metal frames.

B. The following manufactures shall be considered as approved equal for the following luminaire types: Lithonia, Metalux, Hubbell Columbia.

C. Refer to Section 265113 Lighting Accessories for lamp and ballast specifications.

2.2 LIGHT FIXTURE SCHEDULE

A. LED Light Fixtures

Type LRG — Recessed, grid type, lay-in, #12 pattern, 0.125” thick, prismatic lens, 0-10V dimming, light emitting diode light fixture, 2 x 4 foot, shall be Lithonia catalog no. 2GTL-4-40L-A12125-EZ1-LP840-PAF, Metalux catalog no. 24-G-R-LD5-42-A125-UNV-L840-HCD-1-PAF, Columbia LLT-24-40-LW-FS-A12F-ED1-U-PAF, Philips 2TG-43L- 840-4-FS-12F-UNV-DIM, or approved equal. This lighting fixture is intended for usage in laboratories, workrooms, corridors, restrooms, and similar areas.

PART 3 - EXECUTION

3.1 Framing members of suspended ceiling systems used to support light fixtures shall be securely fastened to each other and shall be securely attached to the building structure at appropriate intervals.

3.2 Light fixtures so supported shall be securely fastened to the ceiling framing member by clips identified for use with the type of ceiling framing member and fixture. Bolts, screws, or rivets are not acceptable.

3.3 Light fixtures shall be served from a junction box, they shall not be daisy chained together. Light fixtures that share the same ballast may be tandem wired.

END OF SECTION 265100

SECTION 265200 - EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the emergency lighting fixtures for buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

3. The Contractor shall furnish and install all fixtures, as shown on the drawing. Fixtures shall conform to the types and manufacturers as hereinafter specified.

4. The Contractor shall furnish all lamps and necessary hangers, supports, wiring, etc., for installation of fixtures.

B. Related Sections include the following:

1. Division 26 Section "Interior Lighting" for luminaires that have an emergency lighting function that are not specified in this section.

2. Applicable sections of Division 26 - Electrical

1.3 DEFINITIONS

A. CRI: Color-rendering index.

B. HID: High-intensity discharge.

C. LED: Light emitting diode

D. Luminaire: Complete lighting fixture, including ballast housing if provided.

E. Pole: Luminaire support structure, including tower used for large area illumination.

F. Standard: Same definition as "Pole" above.

1.4 SUBMITTALS

A. Shop Drawings: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, for the following:

1. Emergency lighting units and fixtures
2. EXIT lights
3. Fire escape signs

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, “National Electrical Code”

PART 2 - PRODUCTS

2.1 EXIT LIGHTS

A. Exit lights shall be type of mounting as indicated on drawing and shall be cast aluminum, black housing, with brushed aluminum face with 6 inch letters, green LED panel for multi-voltage. They shall be the Sure-Lites CX6G series, Lithonia LESG “Tru-Green” series, or Lightolier LDS-N-G-ASD.

2.2 EMERGENCY LIGHTING UNITS

A. Contractor shall furnish and install battery operated emergency lighting units as shown on the drawing and hereinafter specified.

B. Units shall conform to the Underwriters Laboratory standards and all provisions of the National Code.

C. 4.8 Volt units to operate a maximum of 2 lamps mounted on unit shall be Sure-Lites Model SEL-M-60-R4-SD.

D. 6 Volt Units to operate 2 to 7 lamps, 2 on unit, and 3 to 5 remote, shall be Exide model F-100.

E. Batteries shall be maintenance free lead-calcium capable to full charge within 12 hours and to operate all lamps for 1 1/2 hours of light to and end voltage of 87 1/2 percent.

F. Units shall be provided with solid state automatic charger and switching circuit, automatic overload protection, low voltage disconnect device, automatic brown-out feature, high charge-ready indicator light and push to test switch.

G. Units shall have a self-diagnostic feature.

H. Lamps for 6 Volt units with maximum 2 lamps, shall be Sure-lites model 6T6, tungsten halogen par 36, 6 Watt sealed beam.

I. Lamps for 6 Volt units with 4 to 7 lamps, shall be Exide model H126, 12 Watt halogen.

J. Contractor shall furnish and install remote mounted lamp assemblies as shown on drawing.

K. Remote lamps shall be furnished with a flush mounting single gang stainless steel plate.

2.3 FIRE ESCAPE SIGNS

A. Fire escape signs shall be McPhilben Series 50.

B. Type of mounting, color of letters and number of arrows shall be as noted on drawing.

PART 3 - EXECUTION

3.1 EMERGENCY LIGHTING UNITS

A. Units shall be mounted so that they may easily be removed for service. Wall shelves or brackets shall be designed in such a way that battery units are securely fastened to the mounting unit.

B. Units shall be permanently connected to a 120 Volt AC, 60 cycle, single phase source, in compliance with the National Electric Code. A short piece of sealtite may be used where conduit enters unit.

C. Remote lamps shall be connected to battery unit using wireway and wire size as shown on the drawing. Fixture shall be installed over flush mounted outlet box.

D. Patch and return to original condition any areas cut to facilitate installation of any equipment.

END OF SECTION 265200

SECTION 270500 – COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section shall apply to all Division 27 sections.

1.2 SUMMARY

A. Work Included

1. The work shall be executed in conformity with the drawings, the approved shop drawings, and these specifications.

2. In general, this work shall consist of, but not necessarily be limited to the following:

3. Demolition

4. New Work

B. Work Not Included

C. The Contractor shall refer to Alternates listed in Division 01 and Proposals and shall submit price quotations for the alternates that apply to the electrical work.

1.3 SUBMITTALS

A. Shop Drawings and Samples

1. The Contractor shall submit shop drawings for all major equipment including, but not limited to the following items and/or the items listed in Division 27 sections.

2. Quantity of shop drawings and information to be included shall be as specified in Division 01 - General Requirements.

B. As-Built Drawings

1. Quantity of shop drawings and information to be included shall be as specified in Division 01 - General Requirements.

2. The Contractor shall submit as-built drawings indicating the location of all outlets, junction boxes, and conduit runs; including conduit size, circuit numbers, and number of wires in each run.

C. Certificate of Electrical Inspection: Provide certificate as described in this section.

1.4 QUALITY ASSURANCE

A. Codes and Regulations

1. See Division 01 General Requirements for Codes and Regulations that apply.

2. The latest National Electrical Code shall be observed and shall govern the character of work, style, quantity and the size of all material used.

3. All materials shall conform with the standards of the Underwriter's Laboratories in every case where such standards have been established for the particular type of material in question.

4. All material and equipment shall be UL listed and bear the UL label where such listing and labeling exists.

5. The complete electrical installation shall comply with all the requirements of the MI.O.S.H.A.

6. Codes shall be used as minimum requirements, and where the Specifications or Plans call for an installation that exceeds and does not violate the Code requirements, the Specifications and Plans shall be followed.

B. Character of Work

1. The installation shall be executed in a workmanlike manner and shall present a neat mechanical appearance when completed.

C. Permits and Inspections

1. The Electrical Contractor shall obtain and pay for all permits required by the State of Michigan Labor Department, Electrical Division.

2. The Electrical Contractor shall submit, to precede request for final payment, a copy of the Certificate of Electrical Inspection as required by the State of Michigan.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to individual Division 26 sections for product specifications.

B. Material to be Returned to the Owner

1. Refer to Division 01 - General Requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to Division 01 - General Requirements for items such as examination of premises, coordination with other trades, cutting and patching, connection to present equipment, etc.

B. Equipment Supports

1. Enclosures for communications equipment, and other similar equipment shall be mounted on ½" spacers when mounted in a room on a below grade exterior wall.

END OF SECTION 270500

SECTION 271400 – TELEPHONE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. This Section specifies the telephone raceway system for buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.

3. The Contractor shall furnish and install a complete telephone raceway system with all necessary components for a complete system as described in the specification and shown on the drawings.

4. The Contractor shall furnish and install all cable, terminal blocks, punch blocks, and all necessary components from the facility Telephone Utility Room to each outlet designated to have cable, and leave 12” of cable at each outlet for termination by others.

B. Work Not Included

1. The telephone wiring, terminations, and connectors shall be provided and installed by others.

C. Related Sections include the following:

1. Applicable sections of Division 26 - Electrical

1.3 SUBMITTALS

A. Shop Drawings:

1. Telephone cables
2. Punch down blocks and all related components
3. Outlets

PART 2 - PRODUCTS

2.1 TELEPHONE CABINETS

A. Telephone cabinets shall be 24 inches wide, 24 inches high and 6 inches deep, flush mounting and supplied with 3/4 inch plywood backboard installed in the cabinet.

B. Panel front shall be equipped with Corbin Catalog No. 15751 catch, lock, and No. TEU-1 key.

C. Cabinets may be standard electric panelboard boxes, such as manufactured by General Electric, or Westinghouse.

2.2 TELEPHONE OUTLETS

A. Telephone outlets shall be Hubbell catalog number SSF12, SSF14, SSF16 (Stainless steel faceplate 2, 4, or 6 openings single gang) or SSF204, SSF206, SSF209 or SSF212 (Stainless steel faceplate 4, 6, 9, or 12 openings double gang). Fill all outlet positions with blank fillers.

2.3 TELEPHONE CABLE

A. Telephone cable shall be twisted pair communication cable and shall meet EIA/TIA 568 Category 5e requirements and shall be CMP rated. Cables shall be four pair with a gray overall jacket, Avaya Catalog number 66131418 (Cat 5e), or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. In general, outlets shall be installed 18 inches above finished floor unless otherwise noted.

3.2 WORK IN EXISTING WALLS

A. Flush telephone outlets installed in existing walls shall consist of single gang, extra deep, non-metallic, "old work" boxes such as Carlon catalog no. B114R or Union Box catalog no. 6070-4.

B. Telephone wire shall be fished in the wall and run to the communication closet on the respective floor. Wire shall be anchored every three feet to structural members, slabs, or walls; they shall not be laid on or fastened to channels of suspended ceilings, duct work, conduit, piping, or other building systems.

C. Where cables are run parallel they shall be bundled and anchored every three feet same as above.

3.3 WORK IN NEW WALLS

A. Flush telephone (communication) outlets installed in new walls shall consist of the following:

1. An extra deep single gang steel box with a 3/4" conduit installed to the cable tray system or the closest Floor Communication Room.

2. Two of these outlet boxes shall be installed at all locations where telephone (communications) is needed. The boxes shall be spaced approximately six inches apart.

3.4 WALL MOUNTED TELEPHONE OUTLET BOXES

A. Wall mount telephone outlet boxes shall be an extra deep single gang steel box with a 3/4" conduit installed to the cable tray system or the closest Floor Communication Room. The wall space within 12” from the center of the outlet box in all directions shall be kept clear of all other devices, equipment, attachments, items, etc., to allow space for a wall mount telephone set.

3.5 SURFACE OUTLETS

A. Surface telephone outlets shall consist of Wiremold No. 5747 shallow switch and receptacle box.

3.6 TELEPHONE WIRING

A. Telephone wiring shall be the following:

1. Install the number of telephone cables to each outlet as shown on the drawings.

2. Install a feeder cable to each floor. The number of pairs in the feeder shall be equal to the number of telephone outlets on the floor plus fifty, rounded up to the nearest increment of 100 pairs. The conductors in the feeder cable shall be #24 AWG solid annealed copper.

3. All cable shall meet the requirements of NEC 800-3(b).

B. In the Telephone Utility Room and Floor Communications Rooms, all pairs of all telephone cables shall terminate on new punch down terminal blocks, Type 66M Siemens part no. S66M1-50, installed on blue backboards made by Allen Tel, part no. GB183B1. Above each blue backboard install white spool board Allen Tel part no. GB187B1. Pairs shall be tagged indicating the location of the other end of the cable. Cable shall be routed through “D” rings Allen Tel part no. GB13C along outer edge of plywood and across bottom of plywood up to the 66 blocks. Terminate cables on 66 blocks maintaining a 1” loop in each pair.

END OF SECTION 271400

SECTION 280500 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section shall apply to all Division 28 sections.

C. Refer to Section 087100 for hardware on doors with card access controls.

1.2 SUMMARY

A. Work Included

1. The work shall be executed in conformity with the drawings, the approved shop drawings, and these specifications.

2. In general, this work shall consist of, but not necessarily be limited to the following:

3. Demolition

4. New Work

B. Work Not Included

C. The Contractor shall refer to Alternates listed in Division 01 and Proposals and shall submit price quotations for the alternates that apply to the electrical work.

1.3 SUBMITTALS

A. Shop Drawings and Samples

1. The Contractor shall submit shop drawings for all major equipment including, but not limited to the following items and/or the items listed in Division 28 sections.

2. Quantity of shop drawings and information to be included shall be as specified in Division 01 - General Requirements.

B. As-Built Drawings

1. Quantity of shop drawings and information to be included shall be as specified in Division 01 - General Requirements.

2. The Contractor shall submit as-built drawings indicating the location of all outlets, junction boxes, and conduit runs; including conduit size, circuit numbers, and number of wires in each run.

C. Certificate of Electrical Inspection: Provide certificate as described in this section.

D. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.

1.4 QUALITY ASSURANCE

A. Codes and Regulations

1. See Division 01 General Requirements for Codes and Regulations that apply.

2. The latest National Electrical Code shall be observed and shall govern the character of work, style, quantity and the size of all material used.

3. All materials shall conform with the standards of the Underwriter's Laboratories in every case where such standards have been established for the particular type of material in question.

4. All material and equipment shall be UL listed and bear the UL label where such listing and labeling exists.

5. The complete electrical installation shall comply with all the requirements of the MI.O.S.H.A.

6. Codes shall be used as minimum requirements, and where the Specifications or Plans call for an installation that exceeds and does not violate the Code requirements, the Specifications and Plans shall be followed.

B. Character of Work

1. The installation shall be executed in a workmanlike manner and shall present a neat mechanical appearance when completed.

C. Permits and Inspections

1. The Electrical Contractor shall obtain and pay for all permits required by the State of Michigan Labor Department, Electrical Division.

2. The Electrical Contractor shall submit, to precede request for final payment, a copy of the Certificate of Electrical Inspection as required by the State of Michigan.

1.5 WARRANTY

A. Refer to Division 01 - General Requirements.

B. Refer to individual Division 26 sections for any additional warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to individual Division 26 sections for product specifications.

B. Material to be Returned to the Owner

1. Refer to Division 01 - General Requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to Division 01 - General Requirements for items such as examination of premises, coordination with other trades, cutting and patching, connection to present equipment, etc.

B. Equipment Supports

1. Enclosures for communications equipment, and other similar equipment shall be mounted on 1/2" spacers when mounted in a room on a below grade exterior wall.

END OF SECTION 280500

SECTION 280800 – COMMISSIONING OF FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the commissioning process for the fire alarm systems for buildings and structures.

B. Related Sections:

1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

C. Start-up of equipment and systems for the fire alarm systems, shall be done by or with a trained manufacturer's representative who can check and report on all items such as installation, operation, and see that the equipment or system starts and operates properly.

D. Testing shall be performed at the convenience of the Owner and with the Owner’s representatives present and the manufacturer’s representative of the equipment and/or system present.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances.”

1.5 UNIT PRICES

A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Division 01 Section "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in fire alarm systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.7 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual fire alarm systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing and adjusting of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual

1.8 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for fire alarm systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.

5. Certificate of readiness certifying that fire alarm systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing and adjusting reports.

1.9 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that fire alarm systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that fire alarm instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing and adjusting procedures have been completed and that testing and adjusting reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA

3.2 TESTING VERIFICATION

A. Prior to performance of testing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing Work, and provide access for the CxA to witness testing Work.

C. Provide technicians, instrumentation, and tools to verify testing of fire alarm systems at the direction of the CxA.

1. The CxA will notify testing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, a deviation of more than 10 percent from an item's sensing set-point or output level, or an item's failure to function properly. Failure of an item shall result in rejection of final testing and adjusting report.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of fire alarm testing shall include all components, equipment, and systems as outlined in outlined later in this section.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response to input signals.

D. The CxA along with the Electrical Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the fire alarm system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests

3.4 FIRE ALARM SYSTEM

A. Fire alarm and smoke detector systems shall be tested by operating each pull station and activating all system sensors to verify proper operation.

B. Fire alarm notification devices, visual, audio, and transmitted signals, shall each be tested to verify proper operation.

C. Any fire voice communications systems shall be tested to verify correct operation of all voice inputs and all speakers.

END OF SECTION 280800

SECTION 283100 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. This Section specifies the fire-alarm system for buildings and structures.

2. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein for a complete operating system.

3. Provide 8 hours of factory service engineer training on the operation of the manufacturer's fire-alarm system in general and on the system installed on this project.

1.3 DEFINITIONS

A. FACP: Fire Alarm Control Panel
B. FARCP: Fire Alarm Remote Control Panel
C. NACP: Fire Alarm Notification Appliance Control Panel
D. FAA: Fire Alarm Annunciator Panel
E. FAIGA: Fire Alarm Interactive Graphic Annunciator
F. FFCP: Fire Fighter Control Panel
G. LED: Light-emitting diode
H. NICET: National Institute for Certification in Engineering Technologies
I. Definitions in NFPA 72 apply to fire-alarm terms used in this Section

1.4 SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS

A. Fire-alarm system shall be a multiplexed point addressable type, non-coded, 24VDC, electrically supervised, U.L. approved, dedicated to fire-alarm service only.

1. Alarm circuits shall be Class B, Style 4 for signaling line circuits and Class B, Style Y for notification appliance circuits for all academic or business occupancies. Speakers and strobes shall be operable over a single ground. The system shall comply with NFPA 72.

2. Alarm circuits shall be 4-wire Class A, Type Z looped back to the control panel for all dormitories. Speakers and strobes shall be operable over a single open or ground. The system shall comply with NFPA 72.

B. Device locations and ratings indicated on Drawings are minimum requirements, established for general scope and coordination purposes. In addition to devices shown on drawings, provide additional and supplemental devices as required to meet the requirements of the authorities having jurisdiction (AHJ), the fire alarm manufacturer, and all applicable codes up until bids are due. Any deviations including material and labor shall be included in the final bid price.

C. Fire-alarm vendor shall provide sound pressure level calculations demonstrating compliance with NFPA 72 and establish quantities and tap settings of audible devices. Contractor shall modify settings as required to achieve proper levels for field conditions.

1. If sound level is not acceptable to Owner, the Contractor shall adjust tap settings or add additional devices as required to achieve proper levels for field conditions.

D. A complete functional system meeting the requirements of this specification, applicable codes and AHJ requirements shall be provided.

E. Fire-alarm evacuation signal initiation shall be by one or more of the following devices:

1. Manual stations
2. Smoke detectors
3. Heat detectors
4. Automatic sprinkler system water flow
5. Fire extinguishing system operation
6. Fire standpipe system

F. Fire-alarm evacuation signal shall initiate the following actions:

1. Alarm notification appliances shall operate continuously.
2. Identify alarm at the FACP, FAIGA and FAA.
3. Illuminate the respective LEDs on any modular bullet annunciators.
4. Transmit an alarm signal to the remote alarm receiving station via contact closures.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating and air-conditioning equipment controls to fire-alarm mode.
8. Close smoke dampers in air ducts of system serving zone where alarm was initiated.
9. Record events in the system memory.
10. Record events by the system printer.
11. Record events to On-Point™.

G. Supervisory signal initiation shall be by one or more of the following devices or actions and will operate the trouble signal:

1. Operation of a fire-protection system or standpipe water flow switch.
2. Low-air-pressure switch operation on a dry-pipe or pre-action sprinkler system.
3. Operation of a valve tamper switch.
4. Fire-pump power failure, including a dead-phase or phase-reversal condition.
5. Fire-pump running.

The MSU Pavilion for Agriculture is the only building on campus where the fire department will respond to a Supervisory condition. All other building require a general alarm condition.

H. System trouble signal initiation shall be by one or more of the following devices or actions:

1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at the FACP.
4. Ground or a single break in FACP internal circuits.
5. Abnormal ac voltage at the FACP.
6. A break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at the FACP, FAGA or FAA.
9. Dirty smoke or heat detector.

I. Provide connection to and capability of transmitting separate signals to the remote supervising station (MSU Police) via contact closure through security panel for the following:

1. Evacuation plan
2. System trouble
3. Sprinkler and/or standpipe water flow indication
4. Sprinkler and/or standpipe water flow supervisory
5. Duct smoke detectors
6. Area smoke detectors (for spaces and smoke dampers)
7. First smoke for smoke detectors cross zoned

J. The fire alarm system shall seamlessly integrate with the existing National Time and Signal On-Point™ Central monitoring system, providing the capability of remote notification to emergency responders and critical MSU staff members providing text and/or email messaging of the alarm location details.

1. Upon receipt of an alarm text or email message the emergency responder and/or MSU staff member shall be capable of remote access to On-Point™ Central for detailed building map viewing of the alarm point location identical to the map, which is displayed on the building's FAIGA.
2. A minimum of one remote access user account shall be available to the responding fire department dispatch center for advanced building map viewing of the alarm event.
3. The On-Point™ Central user interface shall store system events in one of four event queues represented by alarm, supervisory, trouble, or monitor.

K. System Trouble and Supervisory Signal Actions: Sound trouble signal and annunciate at the FACP, FFCP, FAIGA, and FAA.

L. There will be a "Trouble" silence switch located in the fire-alarm control panel and local annunciator that when operated will silence the audible "Trouble" devices while leaving the visual "Trouble" devices illuminated until the "Trouble" is corrected.

M. Sprinkler water flow shall sound general evacuation alarm and will be annunciated in the fire-alarm annunciator panel and activate the audible trouble devices.

N. The Fire Alarm System Control Panel shall be capable of system device disabling providing:

1. Individual and/or group disabling including but not limited to area smoke detectors, duct smoke detectors, fire pump, water-flow, pull stations, tamper switches, strobes, speakers, and door holders (held open).
2. A minimum of six front panel programmable disable switches with an associated LED indicating the state of the programmed disable function.
3. The front panel programmable disable switches shall be:
    a. Accompanied with an associated LED indicating the state of the switch.
    b. Located behind a locked Fire Alarm System Control Panel providing clear visibility and direct access. Embedded software switches using a menu driven user interface does not meet the requirement of this specification.
    c. Duplicated on the FAIGA in the Control Panel screen.
    d. Programmed to provide a system trouble on activation of the switch.
    e. Programmed disabled options approved by Owner.

O. Smoke/Heat Detectors:

1. Initiation of one smoke or heat detector shall sound the general evacuation alarm and send a signal to FACP, FARCP, FAIGA, FAA, On-Point™, and the Campus Security System.

2. When area smoke detectors are cross zoned, initiation of one smoke detector in each zone shall be required to sound the general evacuation alarm and send a signal to FACP, FAIGA, FAA, On-Point™, the building DDC, and the Campus Security System.

    a. Initiation of one smoke detector shall send a first smoke supervisory signal to the FACP, FARCP, FAIGA, FAA, On-Point™ , Campus Security System, and sound local sounder base in room.

3. In academic buildings, automatic magnetic door holders will release when any smoke detector adjacent to door(s) is activated. In dormitories, all automatic magnetic door holders shall release on any general evacuation alarm.

P. FARCP's and NACP's shall be applied and located as approved by the Owner and Engineer. Signaling and notification circuits originating from these panels shall only serve devices on the same floor that the panel resides. Exceptions to this shall only be by approval of the Owner.

Q. The use of an un-intelligent breakout enclosures housing circuits originating from other floors in lieu of an intelligent fire alarm control panel does not meet the requirement of this specification. Exceptions to this shall only be by approval of the Owner.

R. Provide the elevator recall fire alarm equipment when required on campus. See the diagram on Electronic Safety and Security detail on the MSU Planning and Construction website.

1.5 SUBMITTALS

A. General Submittal Requirements:

1. Refer to Division 01 – Specification Sections.
2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified fire-alarm technician, Level III minimum.
c. Licensed or certified by authorities having jurisdiction.

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

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire-alarm Systems" Chapter in NFPA 72.

2. Shop drawings shall include:

a. Fire-alarm system description
b. Fire-alarm control panel (FACP) including layout of all modules
c. Fire-alarm graphic annunciator panel (FAIGA)
d. Fire-alarm remote control panel (FARCP)
e. Fire-alarm remote annunciator (FAA)
f. Fire-alarm initiation devices
g. Fire-alarm signal devices
h. Fire-alarm one-line diagram
i. Fire-alarm wiring details
j. Fire-alarm module drawings

3. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer’s standard descriptions for generic systems are not acceptable.

4. Device Address List: Coordinate with final system programming. Allow for two corrections of device/system descriptions.

5. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.

6. Include voltage drop calculations for notification appliance circuits.

7. Wiring diagram:

a. Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show the wiring color code.

b. On all addressable systems, all devices on a loop shall be documented in a sequential order that the trunk enters and leaves them.

c. On all non-addressed device loops, all devices shall have numbers assigned to each device which is directly related to their wiring sequence.

d. Show all break-out boxes.

8. Batteries: Size calculations. Battery size shall be a minimum of 125% of the calculated requirement.

9. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

10. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

11. Include documentation for smoke and heat detectors indicating compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

12. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

13. Voice/Alarm Signaling Service: Equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

14. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

15. Control Module: Provide calculations indicating circuit loading with 20% spare capacity.

D. Qualification Data: For qualified Installer.

E. Field quality-control reports.

F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

a. Frequency of testing of installed components.
b. Frequency of inspection of installed components.

c. Requirements and recommendations related to results of maintenance.
d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.
6. Three complete sets of fire alarm system schematics, maintenance manuals of all system components and modules, and schematics of all modules and circuit boards. Include abbreviated operating instructions and 11" x 17" building drawings with device layout, junction boxes, and conduit runs for mounting in plastic folder inside FACP. Device addressing shall be included on the 11" x 17" building drawings for maintenance.
7. Three copies of the device list and certificate of completion.

G. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

H. As-Built Drawings

1. Contractor shall submit as-built drawings as specified in Division 01 - General Requirements.

2. The Contractor shall submit as-built drawings indicating the location of all devices, addresses, junction boxes, and conduit runs; including conduit size, circuiting and circuit numbers, and number of wires in each run; and the number and sequential wiring of speakers and strobes.. The drawings shall be separate from the electrical drawings. Provide "as-built" drawings in electronic media, CD, minimum AutoCAD 2004 format and Adobe Acrobat pdf format.

1.6 QUALITY ASSURANCE

A. Codes and Standards

1. Americans with Disabilities Act
2. National Electrical Code
3. National Fire Protection Agency
4. Underwriter's Laboratory

B. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

C. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

D. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

E. 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.

F. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

G. Guarantee

1. The Contractor shall provide a written guarantee stating that all work performed and material furnished is free from all defects in workmanship, and material for a period of two years after the equipment has been accepted by the Owner. Final payment or Certificate of Substantial Completion, whichever is issued first, shall constitute Owner acceptance.

2. A 24 hour telephone number or numbers shall be provided for quick service engineering assistance concerning hardware and software problems. There shall be provisions made for getting an expert on the scene quickly should the need arise, minimum 8 hour on site response time.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner no fewer than two weeks in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without the Owner's written permission.

1.8 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. If any interruption of the existing or new fire alarm system is required the Contractor must provide a "fire watch" for that area of the building.

C. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver materials to the IPF Electronics Shop though the Project Representative.

1. Notification Appliances: Quantity equal to 10 percent of amount installed, but not less than 1 unit and not more than 5 of each type installed.
2. Smoke, Thermal, and Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type and not more than 10 of each type installed.
3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type and not more than 5.
4. Duct Detectors: Minimum of 2 of each type installed.
5. Keys and Tools: All extra sets for access to locked and tamper proofed components.
6. Fuses: Two of each type installed in the system.
7. Spare controller module and monitor module, one of each type to be kept on hand at MSU IPF electronic shop for maintenance.
8. Manual Stations: Quantity of two for each type installed.
9. NAC’s and PAD’s: Quantity of two for each type installed.

1.11 PROJECT CONDITIONS

A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner no fewer than 10 days in advance of proposed interruption of fire alarm service.
2. Do not proceed with interruption of fire alarm service without Owner’s permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Fire Alarm Control Panel and Equipment:

a. National Time and Signal Corporation, 900 Series

2.2 FIRE ALARM CONTROL PANEL (FACP)

A. General Description:

1. Modular, power-limited design with electronic modules, UL 864 listed.

2. Addressable initiation devices that communicate device identity and status.

a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.

b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu:

1. Annunciator and Display: Liquid-crystal type, six inch, 640 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display, and control commands; and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. FACP User Interface: System events shall be stored in one of four event queues represented by alarm, supervisory, trouble or monitor. The alarm event shall have priority over the supervisory, trouble, and monitor event queues with the ability to alternate between queues with a single button depression. On the activation of a system event the following sequence shall occur:

1. On Alarm: The FACP interface shall display the first alarm event with the ability to scroll to the subsequent alarm events via the Alarm Queue button. The FACP interface shall on alarm display the following:

a. The Alarm Queue Led flashes indicating an alarm status is present.
b. A custom message is displayed detailing location.
c. The display shall indicate the number of active alarms present on the system.
d. The Alarm event status shall be identified as an active or restored event.
e. The Floor alarm zone LED is illuminated red indicating which floor(s) are in alarm.
f. The Floor Output LED is illuminated green indicating which floor(s) are sounding.
g. Alarm event acknowledge sequence shall execute as follows:

1) The Alarm Queue button will sequentially step the operator through the alarm events, acknowledging the event on each Alarm Queue button depression. On the completion of acknowledging all alarm events, the Alarm Queue Led illuminates steady.
2) A secondary means to view the alarm events shall be available via the up and down arrows. The Alarm Queue button shall return the display to the last acknowledged event.

3) The FACP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

2. On Supervisory: The FACP interface shall display the first supervisory event with the ability to scroll to the subsequent supervisory events via the Supervisory Queue button. The FACP interface shall on supervisory display the following:

a. The Supervisory Queue Led flashes indicating a Supervisory status is present.
b. A custom message is displayed detailing location.
c. The display shall indicate the number of active Supervisory(s) present on the system.
d. The Supervisory event status shall be identified as active or restored.
e. The Floor supervisory zone LED is illuminated amber indicating which floor(s) are in supervisory.
f. Supervisory event acknowledge sequence shall execute as follows:

1) The Supervisory Queue button will sequentially step the operator through the supervisory events, acknowledging the event on each Supervisory Queue button depression. On the completion of acknowledging all supervisory events, the Supervisory Queue Led illuminates steady.
2) A secondary means to view the supervisory events shall be available via the up and down arrows. The Supervisory Queue button shall return the display to the last acknowledged event.
3) The FACP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

3. On Trouble: The FACP interface shall display the first Trouble event with the ability to scroll to the subsequent Trouble events via the Trouble Queue button. The FACP interface shall on Trouble display the following:

a. The Trouble Queue Led flashes indicating a Trouble status is present.
b. A custom message is displayed detailing location.
c. The display shall indicate the number of active Troubles present on the system.
d. The Trouble event status shall be identified as active or restored event.
e. The Floor alarm zone trouble LED flashes amber indicating which floor(s) are in trouble.
f. Trouble event acknowledge sequence shall execute as follows:

1) The Trouble Queue button will sequentially step the operator through the trouble events, acknowledging the event on each Trouble Queue button depression. On the completion of acknowledging all trouble events, the Trouble Queue Led illuminates steady.
2) A secondary means to view the trouble events shall be available via the up and down arrows. The Trouble Queue button shall return the display to the last acknowledged event.
3) The FACP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

4. On Monitor: The FACP interface shall display the first Monitor event with the ability to scroll to the subsequent Monitor events via the Monitor Queue button. The FACP interface shall on Monitor display the following:

    a. The Monitor Queue Led flashes indicating a monitor status is present.
    b. A custom message is displayed detailing location.
    c. The display shall indicate the number of active Monitors present on the system.
    d. The Monitor event status shall be identified as active or restored event.
    e. Monitor event acknowledge sequence shall execute as follows:

        1) The Monitor Queue button will sequentially step the operator through the monitor events, acknowledging the event on each Monitor Queue button depression. On the completion of acknowledging all monitor events, the Monitor Queue Led illuminates steady.
        2) A secondary means to view the monitor events shall be available via the up and down arrows. The Monitor Queue button shall return the display to the last acknowledged event.
        3) The FACP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

D. Circuits

1. Signaling Line Circuits: NFPA 72, Class B, Style 4.

    a. System Layout: Install no more than 50 percent capacity addressable devices on each signaling line circuit (not to exceed 60 devices per loop maximum).

2. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.

    a. Audible/Speaker Circuit: No more than 50 percent capacity.
    b. Visual Circuit: No more than 50 percent capacity.

3. Actuation of alarm notification appliances, emergency voice communications, annunciation, smoke control, and actuation of suppression systems shall occur within 10 seconds after the activation of an initiating device.

4. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown providing a break in the circuit will cause mechanical equipment to shut down.

E. Notification-Appliance Circuit: Operation shall sound in a three pulse temporal pattern.

1. A pre-recorded digital voice message, complying with ANSI S3.41 shall be provided but not activated.

2. Amplifier output voltage shall be 70 volts with speakers connected at 70 volts.

F. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP after initiating devices are restored to normal.

1. Silencing-switch operation halts alarm operation of audible notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained. The visual notification appliances shall continue to operate.

2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.

3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

G. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a print-out of the final adjusted values on the system printer.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble and water flow through auxiliary contacts connected to the existing security system panel and through existing central control building energy management panel.

J. Voice/Alarm Signaling Service: A central emergency communication system with microphone, preamplifier, amplifier, and tone generator located in the FACP.

1. System shall be capable of indicating number of alarm channels for automatic, simultaneous transmission of different announcements to different zones, or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall be UL 1711 listed.

a. Allow the application of and evacuation signal to indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.

b. Programmable tone and message sequence selection.

c. Standard digitally recorded messages for "Evacuation" and "All Clear”.

d. Generate tones to be sequenced with audio messages of the type recommended by NFPA 72 and that are compatible with tone patterns of the notification-appliance circuits of the FACP.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones.

K. Portable Printer: Ports shall be RS-232 for system printer.

1. Provide printer interface card for unsupervised interface with printer.

2. Provide printer in nearest mechanical or communication room closest to FACP. This printer is a provided on a project specific basis and is not required for all new installations.

L. Printout of Events: On receipt of signal, when printer is installed, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble), and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including the same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

M. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory signal shall be powered by the 24-V dc source.

1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.

N. Secondary Power: Provide standby batteries with charger for operation of the system in the supervisory mode for up to 24 hours followed by a minimum of 5 minutes of an alarm condition in the event of power failure.

1. Batteries: Sealed lead calcium.
2. Battery and Charger Capacity: Comply with NFPA 72.

O. Surge Protection:

1. Install surge protection on normal ac power for the FACP and its accessories.

2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.

P. Provide Corbin catalog no. 15751 camlock and no. TEU-1 key.

Q. Event History Log: Minimum 300 event history log of alarm, trouble and sprinkler supervisory alarm conditions and shall be complete with one-man system walk test.

R. Provide FACP or remote panels sized to accommodate a minimum of two additional initiation, two speakers and four strobe circuits.

S. Provide minimum of fourteen sets of normally open and normally closed auxiliary contacts (two for alarm, two for trouble, two for waterflow, two for first smoke, and six spare).

2.3 FIRE ALARM REMOTE CONTROL PANEL (FARCP)

A. General Description:

1. Modular, power-limited design with electronic modules, UL 864 listed.

2. Addressable initiation devices that communicate device identity and status to the main FACP.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line, 40 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. FARCP User Interface: System events shall be stored in one of four event queues represented by alarm, supervisory, trouble or monitor. The alarm event shall have priority over the supervisory, trouble, and monitor event queues with the ability to alternate between queues with a single button depression. On the activation of a system event the following sequence shall occur:

1. On Alarm: The FARCP interface shall display the first alarm event with the ability to scroll to the subsequent alarm events via the Alarm Queue button. The FACP interface shall on alarm display the following:

a. The Alarm Queue Led flashes indicating an alarm status is present.
b. A custom message is displayed detailing location.
c. The display shall indicate the number of active alarms present on the system.
d. The Alarm event status shall be identified as an active or restored event.
e. The Floor alarm zone LED is illuminated red indicating which floor(s) are in alarm.
f. The Floor Output LED is illuminated green indicating which floor(s) are sounding.
g. Alarm event acknowledge sequence shall execute as follows:

1) The Alarm Queue button will sequentially step the operator through the alarm events, acknowledging the event on each Alarm Queue button depression. On the completion of acknowledging all alarm events, the Alarm Queue Led illuminates steady.
2) A secondary means to view the alarm events shall be available via the up and down arrows. The Alarm Queue button shall return the display to the last acknowledged event.
3) The FARCP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

2. On Supervisory: The FARCP interface shall display the first supervisory event with the ability to scroll to the subsequent supervisory events via the Supervisory Queue button. The FARCP interface shall on supervisory display the following:

    a. The Supervisory Queue Led flashes indicating a Supervisory status is present.
    b. A custom message is displayed detailing location.
    c. The display shall indicate the number of active Supervisory(s) present on the system.
    d. The Supervisory event status shall be identified as active or restored.
    e. The Floor supervisory zone LED is illuminated amber indicating which floor(s) are in supervisory.
    f. Supervisory event acknowledge sequence shall execute as follows:

        1) The Supervisory Queue button will sequentially step the operator through the supervisory events, acknowledging the event on each Supervisory Queue button depression. On the completion of acknowledging all supervisory events, the Supervisory Queue Led illuminates steady.
        2) A secondary means to view the supervisory events shall be available via the up and down arrows. The Supervisory Queue button shall return the display to the last acknowledged event.
        3) The FARCP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

3. On Trouble: The FARCP interface shall display the first Trouble event with the ability to scroll to the subsequent Trouble events via the Trouble Queue button. The FACP interface shall on Trouble display the following:

    a. The Trouble Queue Led flashes indicating a Trouble status is present.
    b. A custom message is displayed detailing location.
    c. The display shall indicate the number of active Troubles present on the system.
    d. The Trouble event status shall be identified as active or restored event.
    e. The Floor alarm zone trouble LED flashes amber indicating which floor(s) are in trouble.
    f. Trouble event acknowledge sequence shall execute as follows:

        1) The Trouble Queue button will sequentially step the operator through the trouble events, acknowledging the event on each Trouble Queue button depression. On the completion of acknowledging all trouble events, the Trouble Queue Led illuminates steady.
        2) A secondary means to view the trouble events shall be available via the up and down arrows. The Trouble Queue button shall return the display to the last acknowledged event.
        3) The FARCP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

4. On Monitor: The FARCP interface shall display the first Monitor event with the ability to scroll to the subsequent Monitor events via the Monitor Queue button. The FACP interface shall on Monitor display the following:

    a. The Monitor Queue Led flashes indicating a monitor status is present.
    b. A custom message is displayed detailing location.
    c. The display shall indicate the number of active Monitors present on the system.
    d. The Monitor event status shall be identified as active or restored event.
    e. Monitor event acknowledge sequence shall execute as follows:

        1) The Monitor Queue button will sequentially step the operator through the monitor events, acknowledging the event on each Monitor Queue button depression. On the completion of acknowledging all monitor events, the Monitor Queue Led illuminates steady.
        2) A secondary means to view the monitor events shall be available via the up and down arrows. The Monitor Queue button shall return the display to the last acknowledged event.
        3) The FACP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

D. Circuits:

1. Signaling Line Circuits: NFPA 72, Class B, Style 4.

    a. System Layout: Install no more than 50 percent capacity addressable devices on each signaling line circuit (not to exceed 60 devices per loop maximum).

2. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.

    a. Audible/Speaker Circuit: No more than 50 percent capacity.

    b. Visual Circuit: No more than 50 percent capacity.

3. Actuation of alarm notification appliances, emergency voice communications, annunciation, smoke control, and actuation of suppression systems shall occur within 10 seconds after the activation of an initiating device.

4. Electrical monitoring for the integrity of wiring external to the FARCP for mechanical equipment shutdown providing a break in the circuit will cause mechanical equipment to shut down.

E. Notification-Appliance Circuit: Operation shall sound in a three pulse temporal pattern.

1. A pre-recorded digital voice message, complying with ANSI S3.41 shall be provided but not activated.

2. Amplifier output voltage shall be 70 volts with speakers connected at 70 volts.

F. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

G. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

H. Provide Corbin catalog no. 15751 camlock and no. TEU-1 key.

2.4 FIRE ALARM INTERACTIVE GRAPHIC DISPLAY (FAIGA)

A. Manufacturers:

1. National Time and Signal Corporation, Model IGD-1042

B. The FAIGA shall meet UL864.

C. The fire alarm graphic annunciator shall be the National Time and Signal On-Point™ interactive graphical display enabled with the On-Point™ Fire Alarm Manager and Maintenance Manager.

D. The Fire Alarm Manager shall store system events in one of four event queues represented by alarm, supervisory, trouble or monitor. The alarm event shall have priority over the supervisory, trouble, and monitor event queues with the ability to alternate between queues with a single button depression. On the activation of a system event the following sequence shall occur:

1. On Alarm: The FAIGA interface shall display:

a. The Graphical alarm screen providing on a single screen of view:

1) Alarming device as it relates to the building's elevation and floor location.
   a) The alarming device on the floor shall illuminate red.
   b) The alarming floor shall illuminate red
2) The alarm building map shall color code the building rooms as follows:
   a) Elevator and stairwells in a rose color
   b) Residence rooms in a yellow color
   c) Storage rooms in a brown color
   d) Mechanical and electrical room in a lime color
   e) Offices in a light blue color
   f) Restrooms in a tan color
3) The FAIGA shall display the Alarm Queue. The Alarm Queue event nomenclature shall identify:
   a) Event type
   b) Custom location message
   c) Time and date of the alarm
   d) Time and date of the restoral
4) The alarm screen shall provide visible marking correlation between the selected alarming device icon located on the building map and the alarming device's queue event location.

5) Display the Fire Pumps status indicating active or non-active state for phase reversal, power loss, and pump running.
6) The alarm screen shall be capable of viewing the supervisory, trouble, and monitor screens with a single button depression with the capability of returning to the alarm screen on a single depression of the Alarm Queue button.

2. On Supervisory: The FAIGA interface shall display:

a. The Graphical supervisory screen providing on a single screen of view:

1) Active device as it relates to the building's elevation and floor location.
a) The active device on the floor shall illuminate amber.
b) The active floor shall illuminate amber
2) The supervisory building map shall color code the building rooms as follows:
a) Elevator and stairwells in a rose color
b) Residence rooms in a yellow color
c) Storage rooms in a brown color
d) Mechanical and electrical room in a lime color
e) Offices in a light blue color
f) Restrooms in a tan color
3) The FAIGA shall display the Supervisory Queue. The Supervisory Queue event nomenclature shall identify:
a) Event type
b) Custom location message
c) Time and date of the activation
d) Time and date of the restoral
4) The supervisory screen shall provide visible marking correlation between the selected active device icon located on the building map and the active device's queue event location.
5) Display the Fire Pumps status indicating active or non-active state for phase reversal, power loss, and pump running.
6) The supervisory screen shall be capable of viewing the alarm, trouble, and monitor screens with a single button depression with the capability of returning to the supervisory screen on a single depression of the Supervisory Queue button.

3. On Trouble: The FAIGA interface shall display:

a. The Graphical trouble screen providing on a single screen of view:

1) Active device as it relates to the building's elevation and floor location.
a) The active device on the floor shall illuminate amber.
b) The active floor shall illuminate amber
2) The trouble building map shall color code the building rooms as follows:
a) Elevator and stairwells in a rose color
b) Residence rooms in a yellow color
c) Storage rooms in a brown color
d) Mechanical and electrical room in a lime color
e) Offices in a light blue color
f) Restrooms in a tan color

3) The FAIGA shall display the Trouble Queue. The Trouble Queue event nomenclature shall identify:
   a) Event type
   b) Custom location message
   c) Time and date of the activation
4) The trouble screen shall provide visible marking correlation between the selected active device icon located on the building map and the active device's queue event location.
5) Display the Fire Pumps status indicating active or non-active state for phase reversal, power loss, and pump running.
6) The trouble screen shall be capable of viewing the alarm, supervisory, and monitor screens with a single button depression with the capability of returning to the trouble screen on a single depression of the Trouble Queue button.

4. On Monitor: The FAIGA interface shall display:

   a. The Graphical monitor screen providing on a single screen of view:

      1) Active device as it relates to the building's elevation and floor location.
         a) The active device on the floor shall illuminate green.
         b) The active floor shall illuminate green
      2) The monitor building map shall color code the building rooms as follows:
         a) Elevator and stairwells in a rose color
         b) Residence rooms in a yellow color
         c) Storage rooms in a brown color
         d) Mechanical and electrical room in a lime color
         e) Offices in a light blue color
         f) Restrooms in a tan color
      3) The FAIGA shall display the Monitor Queue. The Monitor Queue event nomenclature shall identify:
         a) Event type
         b) Custom location message
         c) Time and date of the activation
      4) The monitor screen shall provide visible marking correlation between the selected active device icon located on the building map and the active device's queue event location.
      5) Display the Fire Pumps status indicating active or non-active state for phase reversal, power loss, and pump running.
      6) The monitor screen shall be capable of viewing the alarm, supervisory, and trouble screens with a single button depression with the capability of returning to the monitor screen on a single depression of the Monitor Queue button.

E. The Fire Alarm Manager software shall:

1. Annunciate 100 percent of all all initiating device points including but not limited to smoke detectors, heat detectors, pull stations, duct detectors, water flow, supervisory devices, fire pump status, etc.

2. Identify hazardous material storage locations.

3. Emergency equipment locator for but not limited to Fire Alarm Control Panel, fire extinguishers, fire hoses, shut off valves, fire elevators, stairwells, etc.

F. The FAIGA shall use the building floor plans. Room names for rooms containing hazardous materials or that are secure shall only be visible during a fire alarm event or when in the maintenance mode.

G. In the non-emergency mode the FAIGA shall display the following:

1. Alarm Queue
2. Supervisory Queue
3. Trouble Queue
4. Monitor Queue
5. Fire Pump status including pump running, phase reversal, and power loss.

H. The FAIGA's Maintenance Manager Software provides an interactive touch-screen user display to make available facility fire alarm design installation information, active status conditions, and maintenance and service support functions. It shall provide:

1. Enable and Disable capability for input and output devices meeting UL864.
2. Six custom programmable system device disabling switches capable of:
    a. Individual and/or group disabling including but not limited to area smoke detectors, duct smoke detectors, fire pump, water-flow, pull stations, tamper switches, strobes, speakers, and door holders (held open).
    b. Custom programmable disable switches shall have an associated indicator indicating the state of the programmed disable function.
    c. The six custom programmable disable switches shall be replicated on the FACP.
    d. Programmed disabled options approved by Owner.
3. Standard system output device disabling switches capable of:
    a. Device type disable switches per floor or zone for:
        1) All floor/zone sounder bases
        2) All floor/zone Speakers
        3) All floor strobes
        4) All floor/zone door holders
        5) All floor/zone Damper and AHU control
    b. Disable switches shall have an associated indicator indicating the state of the programmed disable function.
4. Standard system input device disabling switches capable of:
    a. Device type disable switches per floor or zone for:
        1) All floor/zone smoke detectors
        2) All floor/zone dorm room smoke detectors
        3) All floor/zone heat detectors
        4) All floor/zone duct detectors
        5) All floor/zone pull stations
        6) All floor/zone water flow
        7) All floor/zone tamper switches
    b. Disable switches shall have an associated indicator indicating the state of the programmed disable function.
5. The capability of device status query checking for trouble, alarm, and dirty detector, prior to re-enabling.

6. Fire Alarm system as-built wire drawings shall be capable of illuminating active alarm, supervisory, trouble, and monitor device points.
7. Fire Alarm riser diagram installation details capable of illuminating active alarm, supervisory, trouble, and monitor device points.
8. Illumination of the active device points include but not limited to smoke detectors, heat detectors, pull stations, duct detectors, water flow devices, supervisory devices, fire pump status, control modules, NACP, etc..
9. System events shall be stored in one of four event queues represented by alarm, supervisory, trouble or monitor. The alarm event shall have priority over the supervisory, trouble, and monitor event queues with the ability to alternate between queues with a single button depression.

I. The FAIGA's user interface shall only display active features and /or functions consistent with this operational standard.

J. The FAIGA shall have a "YOU ARE HERE" arrow showing the location of the FAIGA in the building. Additional FAIGAs shall have the same map orientation with only the "YOU ARE HERE" location change to match relative locations for the additional FAIGAs

K. The FAIDG's software operating system shall be factory engineered by the fire alarm manufacturer. The FAIDG's software operating system software shall integrate emergency and non-emergency functionality seamlessly through one operator interface.

L. The non-emergency functionality includes but not limited to weather maps, directories, event messaging, way finding etc.

2.5 FIRE ALARM ANNUNCIATOR (FAA)

A. General Description: Modular, power-limited design with electronic modules, UL 864 listed.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator and the Fire Alarm System including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. FAA User Interface shall store system events in one of four event queues represented by alarm, supervisory, trouble or monitor. The alarm event shall have priority over the supervisory, trouble, and monitor event queues with the ability to alternate between queues with a single button depression. On the activation of a system event the following sequence shall occur:

1. On Alarm: The FAA interface shall display the first alarm event with the ability to scroll to the subsequent alarm events via the Alarm Queue button. The FAA interface shall on alarm display the following:

a. The Alarm Queue Led flashes indicating an alarm status is present.
b. A custom message is displayed detailing location.

c. The display shall indicate the number of active alarms present on the system.
d. The Alarm event status shall be identified as an active or restored event.
e. Alarm event acknowledge sequence shall execute as follows:

1) The Alarm Queue button will sequentially step the operator through the alarm events, acknowledging the event on each Alarm Queue button depression. On the completion of acknowledging all alarm events, the Alarm Queue Led illuminates steady.
2) A secondary means to view the alarm events shall be available via the up and down arrows. The Alarm Queue button shall return the display to the last acknowledged event.
3) The FACP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

2. On Supervisory: The FAA interface shall display the first supervisory event with the ability to scroll to the subsequent supervisory events via the Supervisory Queue button. The FAA interface shall on supervisory display the following:

a. The Supervisory Queue Led flashes indicating a Supervisory status is present.
b. A custom message is displayed detailing location.
c. The display shall indicate the number of active Supervisory(s) present on the system.
d. The Supervisory event status shall be identified as active or restored.
e. Supervisory event acknowledge sequence shall execute as follows:

1) The Supervisory Queue button will sequentially step the operator through the supervisory events, acknowledging the event on each Supervisory Queue button depression. On the completion of acknowledging all supervisory events, the Supervisory Queue Led illuminates steady.
2) A secondary means to view the supervisory events shall be available via the up and down arrows. The Supervisory Queue button shall return the display to the last acknowledged event.
3) The FACP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

3. On Trouble: The FAA interface shall display the first Trouble event with the ability to scroll to the subsequent Trouble events via the Trouble Queue button. The FAA interface shall on Trouble display the following:

a. The Trouble Queue Led flashes indicating a Trouble status is present.
b. A custom message is displayed detailing location.
c. The display shall indicate the number of active Troubles present on the system.
d. The Trouble event status shall be identified as active or restored event.
e. Trouble event acknowledge sequence shall execute as follows:

1) The Trouble Queue button will sequentially step the operator through the trouble events, acknowledging the event on each Trouble Queue button depression. On the completion of acknowledging all trouble events, the Trouble Queue Led illuminates steady.

2) A secondary means to view the trouble events shall be available via the up and down arrows. The Trouble Queue button shall return the display to the last acknowledged event.
3) The FACP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

4. On Monitor: The FAA interface shall display the first Monitor event with the ability to scroll to the subsequent Monitor events via the Monitor Queue button. The FAA interface shall on Monitor display the following:

a. The Monitor Queue Led flashes indicating a monitor status is present.
b. A custom message is displayed detailing location.
c. The display shall indicate the number of active Monitors present on the system
d. The Monitor event status shall be identified as active or restored event.
e. Trouble event acknowledge sequence shall execute as follows:

1) The Trouble Queue button will sequentially step the operator through the trouble events, acknowledging the event on each Trouble Queue button depression. On the completion of acknowledging all trouble events, the Trouble Queue Led illuminates steady.
2) A secondary means to view the trouble events shall be available via the up and down arrows. The Trouble Queue button shall return the display to the last acknowledged event.
3) The FACP shall be capable of reset, alarm silence, and trouble silence by the Operator free of the need for 100 percent operator acknowledgement of prior events.

2.6 FIRE ALARM PULL STATIONS

A. Manufacturers:

1. National Time and Signal Corporation, 541S.

B. Provide manufacturer recommended back box to accommodate pull stations and addressable modules.

C. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism with integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.

2. Station Reset: Key or wrench operated switch.

D. Pull stations shall be mounted at 48" above finished floor.

2.7 SYSTEM SMOKE DETECTORS

A. Manufacturers:

1. National Time and Signal Corporation, DX900-PHOTO.

B. General Description:

1. Operation of smoke detector heads shall sound evacuation alarm through all speakers and open contacts in duct detector for fan shut down circuits. Alarm and trouble condition shall also be indicated in annunciator panel. Each detector shall have a light to indicate activation and shall hold the signal of fire or smoke until manually reset.

2. Detectors shall lock in on alarm and shall have local or remote test and alarm/trouble capability.

3. Smoke detectors shall be analog-addressable with digital transmission of sensor values.

4. End of line power supervision module shall be compatible with the detectors.

5. UL 268 listed, operating at 24-V dc, nominal.

6. Smoke detectors shall communicate detector status (normal, alarm, or trouble) to the FACP.

7. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.

8. Integral Visual-Indicating Light: Smoke detectors shall indicate detector status. When indicating light is not visible from the floor, a remote indicating light located in the ceiling or wall shall be installed.

9. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

    a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at the FACP to operate at 135 or 155 deg F (57 or 68 deg C).
    c. Provide multiple levels of detection sensitivity for each sensor.

10. Provide integral sounder base for smoke detector indicated when cross zoned.

11. Provide integral sounder base for smoke detectors located in student rooms in residence halls.

C. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.

2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

3. Analog type with digital transmission of sensor valves.

D. Duct Smoke Detectors:

1. Manufacturers:

   a. National Time and Signal Corporation, D900-DD-SL-PHOTO.

2. Photoelectric Smoke Detectors:

   a. Sensor: LED or infrared light source with matching silicon-cell receiver.
   b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

3. UL 268A listed, operating at 24-V dc, nominal.

4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

5. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.

6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

8. Each sensor shall have multiple levels of detection sensitivity.

9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.

10. Relay Fan Shutdown: Provide one (1) set of contacts rated to interrupt fan motor-control circuit.

11. Duct smoke detectors shall include an addressable control module for fan shut-down and/or smoke/fire damper operation.

12. Duct smoke detectors shall include LED output terminals for connection to the associated Bullet Annunciator.

13. Duct smoke detector Bullet Annunciators shall operate independent of the duct smoke detector and shall not rely on the duct smoke detector for power or contract closures.

2.8 DUCT DETECTOR BULLET ANNUNCIATOR

A. Manufacturers:

1. National Time and Signal Corporation, D900 RA.

B. Furnish an addressable microprocessor based remote bullet annunciator panel complete with LED annunciation and switch control, capable of flush or surface mounting.

C. Provide Corbin catalog no. 15751 camlock, no. TEU-1 key.

D. The remote bullet annunciator shall indicate detector status.

E. General: UL 521 listed.

2.9 HEAT DETECTOR

A. Manufacturers:

1. National Time and Signal Corporation, DX900-P-TEMP.

B. Actuated by either a fixed temperature of 135 rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

3. Integral Visual-Indicating Light: Heat detectors shall indicate detector status.

2.10 NOTIFICATION APPLIANCES

A. Manufacturers:

1. National Time and Signal Corporation, SG-CX Series Speaker Strobes and SG Series Strobes.

B. Description: Equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

2. Color: Provide red or white for all wall mounted devices and white for all ceiling mounted devises.

C. Visible Alarm Devices: LED strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "ALERT" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output: 15, 30, 75, 110 candela on the MC Series or 135/185 on the HMC Series as required to meet NFPA 72 requirements.

2. Strobe Leads: Factory connected to screw terminals.

3. Strobe Lights shall be synchronized so that all strobes flash simultaneously.

D. Voice/Tone Speakers:

1. UL 1480 listed.

2. Speakers shall be connected for 70 volt amplifier output.

3. Low-Range Units: Rated 1 to 2 W.

a. Tap all speakers at 1 watt and 2 watts in mechanical rooms, unless otherwise indicated.

4. Mounting: Flush, semi-recessed, or surface mounted; bidirectional as indicated.

5. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.

2.11 INTELLIGENT NOTIFICATION APPLIANCE CONTROL (NACP) PANELS

A. NACP panels shall applied and located as approved by the Owner and Engineer.

B. Furnish separately mounted addressable remote intelligent Notification Appliance Control Panels (NACP) complete with battery standby.

C. Manufacturer’s:

1. National Time and Signal Corporation, D900-RPS-SG Series.

D. NACP panels shall connect to the *DigiComm*™ signaling line circuit and automatically report and display the following system fault conditions at the FACP, FFCP, and the remote annunciators. Each NAC circuit fault shall be required to identify the location of the circuit by way of a unique 40-character message. In addition, the NACP panel shall identify the location of the NACP panel by way of a 40-character message. The NACP shall be capable of annunciating the following trouble conditions:

1. Processor Failure

2. AC Power Failure

3. Battery Fault

4. Ground Fault

5. Open Circuit for each NACP circuit

6. Short Circuit for each NACP circuit

7. Over current for each NACP circuit,

8. Communication Fault

E. Notification Appliance Circuit (NAC)

1. Each NAC shall be capable of delivering 2.5 amps at 24 Vdc nominal.

2. Each NAC shall be capable of class A or B / style Y or Z operation.

F. Auxiliary Power Supply

1. Each NACP panel shall be capable of delivering 0.5 amps at 24 Vdc nominal.

G. Each NACP control panel shall have internal LED status indicators for individual fault conditions.

H. Fire Alarm manufacturers not meeting the Intelligent NACP requirements shall be required to provide notification appliance circuits directly from a FARCP panel in lieu of an Intelligent NACP.

2.12 ADDRESSABLE CONTROL MODULE

A. Provide for integration of auxiliary control functions into the analog signaling circuit. Intelligent analog signaling circuit control module shall have the following capabilities:

1. Communication interaction with the analog signaling circuit having the capability of initiating a control function to an auxiliary device based on a specified event.

2. Provide NO/NC contact pairs rated at 4 amp 120 VAC or 24 VDC for fan shut down and smoke damper closure.

2.13 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

1. All fire alarm cabling regardless of use must be stranded and installed in conduit.

2. Shielded cable is only permitted for use from main FACP to remote FARCP and FAA. The shield on shielded cable shall be continuous throughout the circuit and insulated from ground and any other shielded cable except for the connection point at the panel.

3. Shield cable shall also be used for the microphone circuit.

4. Field devices shall be wired with non-shielded cable.

B. Initiating Device or Signaling Line Circuits and Annunciator Communication Circuit

1. Point addressable wiring shall be one pair of minimum #16 AWG THHN twisted pair stranded copper cable. Size of conductors shall be as recommended by manufacturer unless indicated otherwise on the drawings. If there is a conflict in conductor size, the larger conductor shall be installed if called for on the drawings or required by the manufacturer.

2. Each initiating device circuit shall have a separate circuit number and labeled at every point the circuit is accessible.

C. Notification Appliance Circuit

1. Notification appliance circuits shall be one pair of minimum #14 AWG THHN twisted pair stranded copper cable. Size of conductors shall be as recommended by manufacturer unless indicated otherwise on the drawings. If there is a conflict in conductor size, the larger conductor shall be installed if called for on the drawings or required by the manufacturer.

2. Notification appliance circuits shall be wired with different color, colors not already used in the fire alarm system, or circuits shall be numbered with wire markers on each end of each wire at every termination and joint. Wire markers shall be related to the fire alarm circuit or module connector numbers in the fire alarm control panel.

3. Annunciator communication wiring shall be one pair of minimum size #18 AWG shielded twisted pair cable.

D. Provide two minimum #14 AWG THHN stranded copper wire to devices requiring power such as door magnets and annunciator panel power. Circuits shall be numbered with wire markers on each end of each wire at every termination and joint. Wire markers shall be related to the fire alarm circuit or module connector numbers in the fire alarm control panel. Larger conductors sizes shall be used if required to serve the load.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Smoke or Heat Detector Spacing:

1. Smooth ceiling spacing shall not exceed the rating of the detector.

2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.

3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

D. Audible Alarm-Indicating Devices: Install per NFPA 72 and manufacturers recommendations.

E. Visible Alarm-Indicating Devices: Install per NFPA 72 and manufacturers recommendations.

F. FACP, FARCP and FAIGA: Surface or flush mount as indicated with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Install smoke detector above all fire alarm panels and remote panels.

G. If NACP panels are approved by engineer and MSU, they must all be mounted in an organized and accessible location(s).

H. Any fire alarm device utilizing LED's for visual identification must be mounted so they can be viewed and read from the floor. If mounting cannot be viewed from the floor provide a remote indication device.

I. Provide an intelligent fire alarm control panel FARCP on building floors as required for distributed operation. Each floor's intelligent fire alarm control panel shall provide:

1. Dedicated signaling line circuits originating from the floor's FARCP.
2. Dedicated notification appliance circuits originating from the floor's FARCP and/or intelligent NACP.
3. Alphanumeric Display and System Controls. System controls including but not limited to reset, alarm silence, and trouble silence.

J. The use of an un-intelligent breakout enclosures housing circuits originating from other floors in lieu of an intelligent fire alarm control panel does not meet the requirement of this specification.

3.2 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.
2. TIA/EIA 568-A.

B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

2. Install red fire alarm conduit in all concealed locations including above accessible ceilings, and exposed areas such as mechanical rooms, electrical, and loading docks.

3. Install all fire alarm wiring/circuits entering or exiting junction/pull boxes with a minimum of six inches of slack at each end.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, tie wrap, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

3.3 IDENTIFICATION

A. All wiring shall be labeled where accessible in panels, at devices, junction boxes, pull boxes, etc. All smoke and heat detectors shall be permanently labeled with their respective address typewritten on the outside of the unit base. Marking shall be done with gummed paper tags installed on the surfaces that have been steel wool cleaned and typewritten addresses.

1. Label all notification devices and visible alarm indicating devices with P-touch labeler. Identify circuit number, device number, and end of line.

2. Provide a minimum of ¼ inch high text for all labeling requirements, unless otherwise indicated.

B. Install instructions frame in a location visible from the FACP.

C. Paint all fire alarm junction box covers red.

3.4 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a minimum No. 10 AWG insulated ground wire from main service ground to all FACP.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.

2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.

    a. Include the existing system in tests and inspections.

3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.

4. Testing: Follow procedure and record results complying with requirements in NFPA 72.

5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 SYSTEM COMPLIANCE

A. Manufacturer to provide two years of *On-Point*™ System Compliance connection to include:

1. Reporting of fire alarm events via text and/or email messaging.
2. Remote event viewing of active and historical events via secure browser interface.
3. Remote factory diagnostic support.

3.7 ADJUSTING

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

3.8 DEMONSTRATION

A. Training

1. Provide a minimum of 8 hours of factory service engineer training on the operation of the manufacturer’s fire alarm system in general and on the system installed.

END OF SECTION 283100