



Division of Finance and Business Operations

Wayne State University
Chatsworth Fire Alarm Panel
WSU Project Number 136-195280
Project Labor Work

FOR:

Board of Governors
Wayne State University
Detroit, Michigan

Owner's Agent:

Loretta McClary, Senior Buyer
WSU – Purchasing Department
5700 Cass, Suite 4200
Detroit, Michigan 48202
313-577-3731 / 313-577-3747 fax
ac2843@wayne.edu and copy
rfpteam1@wayne.edu

Owner's Representative:

Chrystal Camilleri, Project Manager
Facilities Planning & Management
Design & Construction Services
5454 Cass
Wayne State University
Detroit, Michigan 48202

Consultant:

DiClemente Siegel Design Inc.
28105 Greenfield Rd.
Southfield, Michigan 48076

June 21, 2013

TABLE OF CONTENTS

Title Page	00001-1
Table of Contents	00002-1

Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract

00005	Information for Bidders	00005-1 thru 00005-2
00100	Instructions to Bidders	00100-1 thru 00100-5
00250	Notice of Pre-Bid Conference	00250-1 thru 00250-2
00300	Form of Proposal & Qualification Statement	00300-1 thru 00300-6
00420	Project Labor Agreements	00420-1 thru 00420-2
00430	Payment Package Document Requirements	00430-1
00500	Agreement Between Contractor and Owner for Construction	00500-1 thru 00500-9
00510	Form of Guarantee	00510-1
00700	General Conditions (A.I.A. A-201)	00700-1
00800	WSU Supplementary General Conditions of the Contract for Construction	00800-1 thru 00800-12
00850	Drawings	00850-1

Division 1 - General Requirements

01000	General Requirements	01000-1 thru 01000-9
01010	Summary of Work (Includes Scope of Work)	01010-1

INFORMATION FOR BIDDERS

OWNER: Board of Governors
Wayne State University

PROJECT: **Chatsworth Fire Alarm Panel**
Project No. **136-195280**

LOCATION: Wayne State University
Chatsworth Tower Apartments, 630 Williams Mall
Detroit, Michigan 48202

OWNER'S AGENT: **Loretta McClary, Senior Buyer**
WSU – Procurement & Strategic Sourcing
5700 Cass, Suite 4200
Detroit, Michigan 48202
313-577-3731 / 313-577-3747 fax
ac2843@wayne.edu & copy rfpteam1@wayne.edu

OWNER'S REPRESENTATIVE: **Chrystal Camilleri, Project Manager**
Facilities Planning & Management
Design & Construction Services
Wayne State University
5454 Cass Avenue
Detroit, Michigan 48202

Architect: **DiClemente Siegel Design Inc.**
28105 Greenfield Rd.
Southfield, Michigan 48076

SPECIAL NOTE: Right to reject any and all proposals, either in whole or in part, and to waive any irregularities therein is reserved by the Owner.

BIDS ADVERTISED: June 21, 2013

BIDDING: Bidding documents may be obtained by vendors from the University Purchasing Web Site at http://www.forms.purchasing.wayne.edu/Adv_bid/Adv_bid.html beginning **June 21, 2013**. When visiting the Web Site, click on the "**Construction**" link in green. Copies of the RFP will not be available at the pre-proposal meeting.

MANDATORY Pre-Bid Conference: **2:00 PM, local time, June 27, 2013** to be held at Wayne State University – **630 Williams Mall, Main Lobby**, Detroit, MI, 48202. Late Arrivals may not be permitted to submit bids.

OPTIONAL Second Walk Through: (If needed) To be determined at the conclusion of the pre-bid conference, by those in attendance.

DUE DATE FOR QUESTIONS: Due Date for questions shall be **July 3, 2013 at 12:00 Noon**. All questions must be reduced to writing and emailed to the attention of **Loretta McClary, Senior Buyer** at **ac2843@wayne.edu**, copy to **Kimberly Tomaszewski, Senior Buyer** at: **rfpteam1@wayne.edu**.

Bids Due: Sealed proposals for lump-sum General Contract will be received at the office of the Purchasing Department located at 5700 Cass Avenue, Suite 4200, Detroit, MI 48202 on **July 8, 2013**, until 2:00 p.m. (local time).

No public bid opening will be held.

Bid Qualification Meeting: Bidders must be available for bid prequalification meeting the day following the bid opening. The lowest qualified bidder will be contacted and requested to meet with Facilities Planning & Management at their office located at 5454 Cass Avenue, Detroit, MI 48202. During the prequalification, the Vendor must provide a Project Schedule and a Schedule of Values, including a list of Contractor's suppliers, subcontractors and other qualifications.

An unsigned contract will be given to the successful Contractor at the conclusion of the Pre Award meeting, if all aspects of the bid are in order. The Contractor has 5 business days to return the contract to the Project Manager for University counter signature. The contractor must also submit a Performance Bond as outlined above and a Certificate of Insurance in the same 5 business day period. In the event the Contractor fails to return the documents in this 5 day period, the University reserves the right to award the contract to the next most responsive bidder.

All available information pertaining to this project will be posted to the Purchasing web site at

http://www.forms.purchasing.wayne.edu/Adv_bid/Adv_bid.html.

Information that is not posted to the website is not available/not known

INSTRUCTIONS TO BIDDERS

OWNER: Board of Governors
Wayne State University

PROJECT: **Chatsworth Fire Alarm Panel**
Project No. **136-195280**

LOCATION: Wayne State University
Chatsworth Tower Apartments, 630 Williams Mall,
Detroit, Michigan 48202

OWNER'S AGENT: **Loretta McClary, Senior Buyer**
WSU – Procurement & Strategic Sourcing
5700 Cass, Suite 4200
Detroit, Michigan 48202
313-577-3731 / 313-577-3747 fax
ac2843@wayne.edu & copy rfpteam1@wayne.edu

1. PROPOSALS

- A. The Purchasing Agent will receive sealed Proposals for the work as herein set forth at the place and until the time as stated in the "Information for Bidders", a copy of which is bound herewith in these specifications. **No public bid opening will be held.**
- B. Proposals shall be for a **lump-sum General Contract for the entire work of the Project as provided in the Form of Proposal.**
- C. Proposals shall be submitted in duplicate on forms furnished with the Bidding documents. The forms must be fully filled out in ink or typewritten with the signature in longhand, and the completed forms shall be without alterations, interlineations, or erasures. Forms shall contain no recapitulations of the work to be done. Each proposal shall be delivered in an opaque sealed envelope, marked "**PROPOSAL**" AND SHALL BEAR THE NAME OF THE PROJECT AND THE NAME OF THE BIDDER. Proposals submitted by telephone or telegraph will not be accepted. Modifications by telephone or telegraph to previously submitted proposals will not be accepted.
- D. **(revised 5-29-2009)** All base bids must be conforming to the detailed specifications and drawings provided by the University, including any Addenda issued. Voluntary Alternates will only be considered if the Contractor has also submitted a conforming base bid. Any stipulation of voluntary alternates or qualifications contrary to the Contract requirements made by the Bidder in or accompanying his proposal as a condition for the acceptance of the Contract will not be considered in the award of the Contract and will cause the rejection of the entire Proposal.
- E. **The competency and responsibility of Bidders will be considered in making the award. The Owner does not obligate himself to accept the lowest or any other bids. The Owner reserves the right to reject any and all bids and to waive any informalities in the Proposals.**

2. PROPOSAL GUARANTEE (revised 3-22-2012)

- A. A certified check or bank draft payable to the Owner, or satisfactory Bid Bond executed by the Bidder and Surety Company, in an amount equal to not less than five percent (5%)

of the maximum proposal amount shall be submitted with each Proposal, which amount may be forfeited to the Board of Governors, Wayne State University, if the successful Bidder refuses to enter into a Contract within ninety (90) days from receipt of Proposals.

- B. Bond must be issued by a Surety Company with an "A rating as denoted in the AM Best Key Rating Guide"
- C. The bid deposit of all bidders except the lowest three will be returned within three (3) days after the bids are opened. After the formal Contract and bonds are approved, the bid deposit will be returned to the lowest three bidders, except when forfeited.
- D. Bid bonds shall be accompanied by a Power of Attorney authorizing the signer of the bond to do so on behalf of the Surety Company.
- E. Withdrawal of Proposals is prohibited for a period of ninety (90) days after the actual date of opening thereof.

3. CONTRACT SECURITY (revised 3-22-2012)

- A. The successful Bidder will be required to furnish a Performance Bond and Labor and Material Payment bond in an amount equal to 100% of the contract award amount, and include such cost in the Proposal, complying with the laws of the State of Michigan. The graduated formula no longer applies.
- B. Performance Bond and Labor and Material Payment Bond shall be from a surety company acceptable to the Owner and made payable as follows:
 - (1) A bond for 100% of the contract award amount to the Board of Governors of Wayne State University, and guaranteeing the payment of all subcontractors and all indebtedness incurred for labor, materials, or any cause whatsoever on account of the Contractor in accordance with the laws of the State of Michigan relating to such bonds.
 - (2) A bond for 100% of the contract award amount to the Board of Governors of Wayne State University to guarantee and insure the completion of work according to the Contract.
- C. The only acceptable Performance Bond shall be the AIA A312 – 2010.
- D. Bond must be issued by a Surety Company with an "A rating as denoted in the AM Best Key Rating Guide".

4. BOND CLARIFICATION

For bids below \$50,000.00,

- A. Bid bond will not be required.
- B. Performance Bond will not be required.

5. INSPECTION

- A. Before submitting his Proposal, each Bidder shall be held to have visited the site of the proposed work and to have familiarized himself as to all existing conditions affecting the

execution of the work in accordance with the Contract Documents. No allowance or extra consideration on behalf of the Contractor will subsequently be made by reason of his failure to observe the Conditions or on behalf of any subcontractor for the same reason.

6. EXPLANATION TO BIDDERS AND ADDENDA

- A. Neither the Owner nor Representative nor Purchasing Agent will give verbal answers to any inquiries regarding the meaning of drawings and specifications, and any verbal statement regarding same by any person, previous to the award, shall be unauthoritative.
- B. Any explanation desired by Bidders must be requested of the Purchasing Agent in writing, and if explanation is necessary, a reply will be made in the form of an Addendum, a copy of which will be forwarded to each Bidder registered on the Bidders' List maintained by the Purchasing Department.
- C. All addenda issued to Bidders prior to date of receipt of Proposals shall become a part of these Specifications, and all proposals are to include the work therein described.

7. INTERPRETATION OF CONTRACT DOCUMENTS

- A. If any person contemplating submitting a bid for the proposed Contract is in doubt as to the true meaning of any part of the drawings, specifications, or other Contract Documents, he may submit to the Purchasing Agent, a written request for an interpretation thereof. The person submitting the request will be responsible for its prompt delivery. Any interpretation of the Contract Documents will be made by an addendum duly issued. A copy of such addendum will be mailed and delivered to each registered Bidder. Each proposal submitted shall list all addenda, by numbers, which have been received prior to the time scheduled for receipt of proposal.

8. SUBSTITUTION OF MATERIALS AND EQUIPMENT*

- A. Whenever a material, article or piece of equipment is identified on the Drawings or in the Specifications by reference to manufacturers' or vendors' names, trade names, catalog numbers, or the like, it is so identified for the purpose of establishing a standard, and any material, article, or piece of equipment of other manufacturers or vendors which will perform adequately the duties imposed by the general design will be considered equally acceptable provided that the material, article, or piece of equipment so proposed is, in the opinion of the Architect, of equal substance, appearance and function. It shall not be purchased or installed by the Contractor without the Architect's written approval.

9. TAXES

- A. The Bidder shall include in his lump sum proposal and make payment of all Federal, State, County and Municipal taxes, including Michigan State Sales and Use Taxes, now in force or which may be enacted during the progress and completion of the work covered.

10. REQUIREMENTS FOR SIGNING PROPOSALS AND CONTRACTS

- A. The following requirements must be observed in the signing of proposals that are submitted:
 - (1) Proposals that are not signed by individuals making them shall have attached thereto a Power of Attorney, evidencing the authority to sign the Proposal in the

name of the person for whom it is signed.

- (2) Proposals that are signed for partnership shall be signed by all of the partners or by an Attorney-in-Fact. If signed by an Attorney-in-Fact, there must be attached to the Proposal a Power of Attorney evidencing authority to sign the Proposal, executed by the partners.
- (3) Proposals that are signed for a corporation shall have the correct corporate name thereof and the signature of the President or other authorized officer of the corporation, manually written in the line of the Form of Proposal following the words "signed by". If such a proposal is signed by an official other than the President of the Corporation, a certified copy of resolution of the Board of Directors, evidencing the authority of such official to sign the bid, shall be attached to it. Such proposal shall also bear the attesting signature of the Secretary of the Corporation and the impression of the corporate seal.

11. QUALIFICATIONS OF BIDDERS

- A. The Owner may request each of the three (3) low bidders to submit information necessary to satisfy the Owner that the Bidder is adequately prepared to fulfill the Contract. Such information may include past performance records, list of available personnel, plant and equipment, description of work that will be done simultaneously with the Owner's Project, financial statement, or any other pertinent information. This information and such other information as may be requested will be used in determining whether a Bidder is qualified to perform the work required and is responsible and reliable.

12. SPECIAL REQUIREMENTS

- A. The attention of all Bidders is called to the General Conditions, Supplementary General Conditions, and Special Conditions, all of which are a part of the Specifications covering all work, including Subcontracts, materials, etc. Special attention is called to those portions dealing with Labor Standards, including wages, fringe benefits, Equal Employment Opportunities, and Liquidated Damages.
- B. Prior to award of the project, the apparent low bidder will be required to produce a schedule of values which will include the proposed subcontractors for each division of work and whether the subcontractor is signatory or non-signatory. A contract will not be issued to the apparent low bidder until this document is provided. A contractor will have one week to produce this document. If the required document is not received within this time, the bidder will be disqualified.

13. NOTICE OF AWARD/ACCEPTANCE OF BID PROPOSAL (revised 12-15-2009)

- A. The Proposal shall be deemed as having been accepted when a copy of the Contract (fully executed by both the vendor and the appropriate signatory authority for the University), with any/all Alternates, Addenda, and Pre-Contract Bulletins, as issued by the office or agent of the Owner has been duly received by the Contractor. After signing the Contracts, the Contractor shall then return all copies, plus any required bonds and certificates of insurance, to the office of the Owner's Representative, at 5454 Cass, Wayne State University, Detroit, MI 48202. Construction will begin when the fully-executed contract has been returned to the Contractor.

14. TIME OF STARTING AND COMPLETION

- A. It is understood that the work is to be carried through to substantial completion with the

utmost speed consistent with good workmanship and to meet the established start and completion dates.

- B. The Contractor shall begin work under the Contract without delay, upon receipt of a fully-executed contract from the Owner, and shall substantially complete the project ready for unobstructed occupancy and use of the Owner for the purposes intended within the completion time stated in the Contract.
- C. The Contractor shall, immediately upon receipt of fully-executed contract, schedule his work and expedite deliveries of materials and performance of the subcontractors to maintain the necessary pace for start and completion on the aforementioned dates.

15. BIDDING DOCUMENTS

- A. Bid specifications are not available at the University, but are available beginning **June 18, 2013** through Wayne State University Purchasing Department's Website for Advertised Bids: http://www.forms.purchasing.wayne.edu/Adv_bid/Adv_bid.html. The plans for this project can be viewed in advance and/or printed from the above website. Copies of the RFP will not be available at the pre-proposal meeting.

B. DOCUMENTS ON FILE (revised 12-2007)

- (1) *Wayne State University Purchasing Department's Website.*
All available information pertaining to this project will be posted to the Purchasing web site at http://www.forms.purchasing.wayne.edu/Adv_bid/Adv_bid.html. Information that is not posted to the website is not available/not known.
- (2) Notification of this Bid Opportunity has been sent to *DUNN BLUE (for purchase of Bid Documents only)*, *DODGE REPORTS*, *REED CONSTRUCTION*, *CONSTRUCTION NEWS* and the *CONSTRUCTION ASSOCIATION OF MICHIGAN (CAM)*.
- (3) Please note: Effective December 1, 2007, bid notices will be sent only to those Vendors registered to receive them via our Bid Opportunities list serve. To register, to http://www.forms.purchasing.wayne.edu/Adv_bid/Adv_bid.html, and click on the "Join our Listserve" link at the top of the page.

NOTICE OF MANDATORY PRE-BID CONFERENCE

PROJECT: **Chatsworth Fire Alarm Panel,**

PROJECT NOS.: **WSU PROJECT NO. 136-195280**

It is **MANDATORY** that each Contractor proposing to bid on this work attend a pre-bid conference at the following location:

Wayne State University
630 Williams Mall, Main Lobby
Detroit MI 48202

2:00 PM, local time, June 27, 2013

The purpose of this conference is to clarify the procedures, scope of work, and to identify any omissions and/or inconsistencies that may impede preparation and submission of representative competitive bids.

An attendance list shall be prepared and minutes of the conference shall be furnished to all those attending.

Any clarifications or corrections that cannot be made at the conference will be by Addendum.

For your convenience a map of the University and appropriate parking lots can be downloaded and printed from: **<http://campusmap.wayne.edu/>** . Guest parking in any of the University student and guest lots is **\$6.00**. A detailed list of Cash & Coin operated lots can be viewed at **http://purchasing.wayne.edu/cash_and_credit_card_lots.php**. Cash lots dispense change in quarters. Due to time constraints, Vendors are encouraged to avoid parking at meters on the street (especially blue "handicapped" meters).

All available information pertaining to this project will be posted to the Purchasing web site at **http://www.forms.purchasing.wayne.edu/Adv_bid/Adv_bid.html**. Information that is not posted to the website is not available/not known.

AGENDA

- I. Welcome and Introductions
 - A. Wayne State University Representatives
 - B. Vendor Representatives
 - C. Sign in Sheet- be sure to include your fax number and email address (LEGIBLY) on the sign in sheet.
- II. Brief Overview of Wayne State University
 - A. Purpose and Intent of RFP.
 - B. Detailed review of the RFP and the requirements for a qualified response.
 - C. Review of all pertinent dates and forms that are REQUIRED for a qualified response.
- III. Vendor Questions/Concerns/Issues
 - A. Questions that can be answered directly by the appropriate person in this meeting will be answered and both question and answer will be recorded in the minutes of the meeting.
 - B. Questions that need to be researched will be answered and a nature of clarification will be emailed to the appropriate ListServ. See
http://www.forms.purchasing.wayne.edu/Adv_bid/Adv_Bid_Listserve.html for a list of ListServ Bid Lists.
 - C. Minutes will be emailed to all participants of the meeting within a reasonable amount of time. (be sure to include your email address/addresses on the sign in sheet)
 - D. Questions and concerns that come up after this meeting are to be addressed to **Loretta McClary**, Purchasing Department. Discussion with other University members is seriously discouraged and could lead to disqualification from further consideration. All questions and answers will be recorded and emailed to all participants of the RFP.
 - E. Due date for questions is **July 3, 2013, 12:00 noon**.
- IV. Proposal Due Date- **July 8, 2013, 2:00 p.m.**
- V. Final Comments
- VI. Adjourn

VENDOR NAME _____

GENERAL CONTRACT - PROPOSAL FORM (revised 1 - 2011)

Please Note – Vendors must Pre-qualify themselves when responding to this bid opportunity. Our Prequalification questions can be found on page 4 of this section.

OWNER: Board of Governors
Wayne State University

PROJECT: Chatsworth Fire Alarm Panel

PROJECT NO.: WSU PROJECT NO. 136-195280

PROJECT TYPE: Construction Type Work

PURCHASING AGENT: Loretta McClary, Senior Buyer
WSU – Procurement & Strategic Sourcing
5700 Cass, Suite 4200
Detroit, Michigan 48202
313-577-3731/ 313-577-3747 fax
ac2843@wayne.edu & copy rfpteam1@wayne.edu

OWNER'S REPRESENTATIVE: Chrystal Camilleri, Project Manager
Design & Construction Services
Facilities Planning & Management
Wayne State University
5454 Cass Avenue
Detroit, Michigan 48202

TO: Board of Governors
Wayne State University
Detroit, Michigan

BASE PROPOSAL:

The undersigned agrees to enter into an Agreement to complete the entire work of the **Chatsworth Fire Alarm Panel** project (WSU Project No. **136-195280**) in accordance with the Bidding Documents for the following amounts:

_____ \$ _____ Dollars

LAWN REPLACEMENT:

The undersigned agrees that, in the event of existing lawn or landscaping damage, due to the Contractor's work, that has not been properly addressed and repaired to the satisfaction of the University, the University may repair/replace the lawn and/or landscaping, and that the expense will be at a **unit cost of \$10.00 per square yard for lawn, and landscaping at a rate of 1.5 times the cost of said repairs**, the full cost of which shall be reimbursed by the contractor.

CONTRACT CHANGE

The undersigned agrees to the following pricing formula and rates

ORDERS: (revised 4-01-2011) for changes in the contract work:

1. For subcontract work, Contractor's markup for handling, overhead, profit and bonding on subcontractor's sell price, shall not exceed **5%**.
 - 1.1. For subcontract work that is provided on a time and material basis, the subcontractor shall be permitted a single markup for handling, overhead, profit and bonding of 5%. When a markup is identified in the subcontractor's hourly labor rate, additional markup on labor is not permitted.
 - 1.1.1 For changes that are based upon a lump sum value, subcontractor shall provide all labor and material back-ups to ensure that duplicative charges are avoided and authorized mark-ups for OH&P can be confirmed
2. For work by his own organization, Contractor's markup for job* and general overhead, profit and bonding shall not exceed **5%** of the net labor** and material costs.

Within 14 days of the project's contract execution Contractor shall provide to the Owner; Subcontractor's hourly labor rate breakdown details. This requirement shall extend to the lowest level of subcontractor participation.

* Job and general overhead includes supervision and executive expenses; use charges on small tools, scaffolding, blocking, shores, appliances, etc., and other miscellaneous job expenses.

** Net labor cost is the sum of the base wages, fringe benefits established by governing trade organizations, applicable payroll taxes, and increased expense for contractor's liability insurance (Workman's Compensation, P.L. and P.D.).

TIME OF COMPLETION:

(revised 4-01-2011)

The Contract is expected to be fully executed on or about 25 calendar days after successful bidder qualification and recommendation of award. The undersigned agrees to start construction **immediately after** receipt of a fully executed contract, and to complete the work as follows:

Substantial Completion will be completed no later than **June 24, 2014**.

LIQUIDATED DAMAGES:

It is understood and agreed that, if project is not completed within the time specified in the contract plus any extension of time allowed pursuant thereto, the actual damages sustained by the Owner because of any such delay, will be uncertain and difficult to ascertain, and it is agreed that the reasonable foreseeable value of the use of said project by Owner would be the sum of **\$250.00, Two Hundred and Fifty Dollars per day**, and therefore the contractor shall pay as liquidated damages to the Owner the sum of **\$250.00, Two Hundred and Fifty Dollars per day** for each day's delay in substantially completing said project beyond the time specified in the Contract and any extensions of time allowed thereunder.

TAXES:

The undersigned acknowledges that prices stated above include all applicable taxes of whatever character or description. Michigan State Sales Tax is applicable to the work. Bidder understands that the Owner reserves the right to reject any or all bids and to waive informalities or irregularities therein.

ADDENDA:

The undersigned affirms that the cost of all work covered by the following Addenda are included in the lump sum price of this proposal.

Addendum No.____Date_____ Addendum No.____Date_____

Addendum No.____Date_____ Addendum No.____Date_____

Addendum No.____Date_____ Addendum No.____Date_____

Addendum No.____Date_____ Addendum No.____Date_____

Addendum No.____Date_____ Addendum No.____Date_____

CONTRACTOR'S PREQUALIFICATION STATEMENT & QUESTIONNAIRE:**Our Minimum Requirements for Construction Bids are:**

WSU considers this project: Construction Type Work.

Criteria	Small Project bid less than \$50,000	Medium Project bid between \$50,001 and \$250,000	Large Project bid between \$250,001 and \$2 million	Very Large Project bid greater than \$2 million
EMR Rating (Experience Modification Rating)	1.0 or Less	1.0 or Less	1.0 or Less	1.0 or Less
Bondable Vendor	N.A.	Required	Required	Required
Length of Time in Construction Business	2 Years	3 Years	5 Years	5 Years
Demonstrated Experience in Projects Similar in Scope and Price in the last 3 years	1 or more	1 or more	2 or more	3 or more
Unsuccessful Projects on Campus in last 3 years	None Allowed	None Allowed	None Allowed	None Allowed
Failure to comply with Prevailing Wage and/or Project Labor requirements	None Allowed	None Allowed	None Allowed	None Allowed
Withdrawn University Bid (with or without Bond forfeiture) within the last 3 years **	2 or less	2 or less	1 or less	1 or less
Company currently not in Chapter 11 of the US Bankruptcy Code	1 Year	2 Years	3 Years	3 Years

** Withdrawal of a bid is subject to the University suspension policy, for a period up to one year.

Failure to complete this form in its entirety will result in your bid being disqualified.

_____ Corporation _____ Individual
 _____ Partnership _____ Joint Venture
 _____ Other (Explain)

1. How many years has your organization been in business as a contractor? _____
2. How many years has your organization been in business under its present business name? _____
3. List states in which your organization is legally qualified to do business. _____

4. Provide the Name and Address of your Liability Insurance Carrier. _____

5. What is your current EMR Rating? _____
The minimum requirement is an EMR Rating of 1.0 or less for all projects. Bidders with a rating higher than 1.0 understand that their bid may be disqualified, at the sole discretion of the University.
6. What percentage of work performed on projects are by company employees; excluding any hired subcontracting and outsourced relationships, for the bid submitted? _____ %
7. What percentage of work performed on your companies behalf are by subcontracted business relationships; disallowing 1099 contracting work forces, for the bid submitted? _____ %
8. Have you ever failed to complete any work awarded to you? If so, attach a separate sheet of explanation. Include the name of the Project, the customer, the dates of the work, and the amount of the contract ?

9. Have you withdrawn a bid after a University bid opening and/or refused to enter into a contract with the University upon notification of award within the last 3 years? If so, state the Project Name and Number, and the date of bid submission below.

10. Has any officer or partner of your organization ever been an officer or partner of another organization that failed to complete a construction contract? If so, attach a separate sheet of explanation.

11. List the construction experience of the principals and superintendents of your company.

Name: _____ Title: _____

Name: _____ Title: _____

Name: _____ Title: _____

12. List the construction Projects, and approximate dates, when you performed work similar in Scope to this project.

Project: _____ Owner: _____

Contract Amount: _____ Date Completed: _____

Project: _____ Owner: _____

Contract Amount: _____ Date Completed: _____

Project: _____ Owner: _____

Contract Amount: _____ Date Completed: _____

13. List the construction Projects, and approximate dates, when you performed work similar in Dollar Amount to this project.

Project: _____ Owner: _____

Contract Amount: _____ Date Completed: _____

Project: _____ Owner: _____

Contract Amount: _____ Date Completed: _____

Project: _____ Owner: _____

Contract Amount: _____ Date Completed: _____

14. Is your Company "bondable"? Yes ____ No ____

15. What is your present bonding capacity? \$ _____

16. Who is your bonding agent?

NAME: _____

ADDRESS: _____

PHONE: (_____) _____

CONTACT: _____

17. Does your company agree to provide financial reports to the University upon request? Failure to agree may result in disqualification of your bid. Yes _____ No _____

18. Does your company agree that all of the Terms and Conditions of this RFP and Vendor's Response Proposal become part of any ensuing agreement? Yes _____ No _____

19. Does your company agree to execute a contract containing the clauses shown in Section 00500 "Agreement Between Contractor and Owner for Construction"? Yes _____ No _____

If "No", clearly note any exceptions to any information contained in the contract documents and include with your proposal.

20. Did your company quote based upon **Project Labor Requirements**? Yes _____ No _____

Note: Contractors submitting proposals for this project may, at the discretion of the University, be required to submit references including contact information to be used to assist in the post bid evaluation process for the subject project

**ACKNOWLEDGEMENT OF
MINIMUM QUALIFICATIONS:**

The undersigned has read and understands the minimum qualifications for University construction projects, and has completed the Prequalification section completely and accurately. The undersigned understands that a contractor, who fails to meet the minimum qualifications **in the category identified for this project, will be disqualified from consideration for the project.**

ACCEPTANCE OF PROPOSAL:

The undersigned agrees to execute a Contract, being the Wayne State University standard form titled "Agreement Between Contractor and Owner for Construction", provided that we are notified of the acceptance of our Proposal within sixty (60) days of the date set for the opening thereof.

The undersigned below understands that the bid will be disqualified if the Prequalification information above is not completed in its entirety.

NAME OF COMPANY: _____

OFFICE ADDRESS: _____

PHONE NUMBER: _____ DATE _____

FAX NUMBER: _____

SIGNED BY:

Signature

(Please print or type name here)

TITLE

A. PROJECT LABOR AGREEMENTS (revised 1-2010)

- A. Contracts requiring prior approval of the Board of Governors between the University and a construction manager, design builder, or general contractor will include a requirement that the construction manager, design builder, or general contractor, with its contractors and subcontractors on that project, enter into a Project Labor Agreement (PLA) in connection with that project, and may specify one or more of the items that the PLA must contain.
- B. Prior approval of the Board of Governors is required for the designing and implementation of construction or renovation of a building or other real property improvement or maintenance project if:
- (1) the project's estimated cost would exceed \$250,000.
 - (2) the project would change the height or footprint of an existing Building other than a temporary building ; or
 - (3) the project would make a material long-term change to the landscape.
- C. A project labor agreement (PLA) is an agreement between a construction manager, design builder, or general contractor engaged on a University construction project and the union(s) representing workers on that project, covering the terms and conditions of employment on that project.
- D. This policy recognizes that numerous contractors have established relationships with unions independent of their relationship with Wayne State University. Nothing in this policy shall be deemed to require that a contractor execute a PLA when doing so would conflict with such a relationship.
- E. Will this Project require the Contractor to complete a Project Labor Agreement:
- ☒ **Yes** Yes, PLA is Required. ☐ No, PLA is not required
(To be completed by the Purchasing Agent)
- F. To maintain compliance with State of Michigan Ordinances, the contractor shall submit a completed certified payroll document [U.S. Department of Labor Form WH347] verifying and confirming the prevailing wage and benefits rates for all employees and subcontractors for each payroll period for work performed on this project. The contractor shall include copies of pay stubs for all employee or contract labor payments related to Wayne State University work. The certified payroll form can be downloaded from the Department of Labor website at <http://www.dol.gov/whd/forms/wh347.pdf>.
- G. A properly executed sworn statement is required from all tiers of contractors, sub-contractors and suppliers which provide services or product of \$1,000.00 or greater. Sworn statements must accompany applications for payment. All listed parties on a sworn statement and as a subcontractor must submit Partial or Full Conditional Waivers for the amounts invoiced on the payment application. A copy of the acceptable WSU Sworn Statement and Waiver will be provided to the awarded contractor.
- H. Apprentices for a skilled trade must provide proof of participation in a Certified Apprenticeship Program and the level of hours completed in the program.

- I. Daily project sign-in sheets and field reports for the project must be turned in weekly.

Note: Contractor invoices WILL NOT be processed until all listed certified payroll documents are received.

- J. A complete copy of the Board Policy can be downloaded at:
http://purchasing.wayne.edu/Project_Labor_Agreements.php

**WAYNE STATE UNIVERSITY
PAYMENT PACKAGE DOCUMENT REQUIREMENTS (Revised 5-20-2011):**

Review and comply with Section 410 of Bid Front End Documents.
Review and comply with Article 15 of the Supplemental General Conditions.

AIA DOCUMENT G702 & G703 – (or facsimile thereof) Payment Application Checklist:

- Correct Project Name – Found on your contract.
- Correct Project Number – Found on your contract.
- Purchase Order Number – Required prior to beginning work.
- Correct Application Number. (i.e. 1, 2, 3, etc.)
- Correct Period Reporting Dates – Applications support docs must be sequential and within application range.
- Approved & Executed Change Orders must be listed. (Cannot invoice for unapproved changes.)
- Schedule of values percentages and amounts match the approved Pencil Copy Review – Signed by the Architect, Contractor, and University Project Manager.
- Correct Dates – Back dating not accepted.
- Signed and Notarized.

SWORN STATEMENT – Checklist:

- List all contractors, sub-contractors, suppliers... ≥ \$1000.00
- Contractor's Sworn Statement amounts must coincide with Column „C“ of the schedule of values document. Any unassigned or uncommitted value of contract shall be shown on an entry „Contractor – Unassigned“ followed by the amount necessary to cause the „contracted to date“ column of the sworn statement to equate with the schedule of value column totals.
- Current Date – Back dating not accepted.
- Signed and Notarized.
- A Sworn Statement is required from every Sub Contractor on the job with a material purchase or sub-contract of \$1,000 or more. (all the way down to the bottom tier)

**DEPT. of LABOR FORM WH-347 – Certified Payroll Checklist:
(Union and Non-Union)**

- For every contractor & sub-contractors work, for each week within the application for payment reporting period. (For every „boot“ on the floor representing the weeks within the application period)
- Wayne State University Project Number – Found on your contract.
- List ALL workers who have worked on the project site.
- Make sure workers addresses are listed.
- NO Social Security Numbers, if present they MUST be blackened out or listed in XXX-XX-1234 format.
- Work classifications based on the job specific Prevailing Wage Schedule descriptions. If you require rates for additional classifications, contact the Michigan Department of Consumer & Industry Services. (Refer to Section 410 of Bid Front End Documents.)
http://www.cis.state.mi.us/bwuc/bsr/wh/revised_rates/whc_tbl.htm
- Apprenticeship program status – proof of enrolled program and current completion required for any workers paid at Apprenticeship rates.
- Rate of Pay verified against the Prevailing Wage Schedule with an hourly costs breakdown of fringes paid. (Refer to attachment for State of Michigan instructions and example)
- Authorized signatures on affidavit.

The Project Manager may provide additional requirements as may apply to individual jobs

WAYNE STATE UNIVERSITY

AGREEMENT BETWEEN THE UNIVERSITY AND CONTRACTOR FOR CONSTRUCTION SERVICES

Executed as of the _____ day of _____, 2010 by and between:

The Board of Governors, Wayne State University
Detroit, Michigan 48202
(The University)

and

Contractor
address
city/state/zip

regarding

Chatsworth Fire Alarm Panel

WSU Project No. 136-195280

In consideration of the mutual covenants and conditions contained herein, the Parties agree as follows:

Article 1 - Scope of Work

- 1.1 This Agreement provides for Project includes **expansion of the existing fire suppression and fire alarm system, new Make –up Air handling Units, IT and TV cabling, interior finishes at Chatsworth Tower Apartments**, located at **Chatsworth Tower Apartments, 630 Williams Mall**. All work is performed on Wayne State's main campus in Detroit Michigan. The documents listed in Article 4 fully define the scope of work.
- 1.2 The Contractor shall furnish all the labor, materials, equipment, services, and supervision to perform all the work shown on the drawings and specifications listed in Article 17, including any addenda issued during the bid phase, and approved change orders issued during the construction phase.
- 1.3 The Contractor shall notify the University in writing within five (5) calendar days when the Contractor discovers any condition that will affect the contract amount or the completion date.

Article 2 - Time of Completion (revised 10-15-2009)

- 2.1 The work to be performed under this Agreement shall commence upon the Contractor's receipt of a fully-executed Agreement. The Contract is expected to be fully executed on or about 25 calendar days after successful bidder qualification and recommendation of award. The undersigned agrees to start construction **immediately after** receipt of a fully executed contract and to complete the work as follows:

Substantial Completion no later than **June 24, 2014**.

Article 3 - The Contract Sum

- 3.1 The University shall pay the Contractor a lump sum amount of \$ indicate amt. in no. (indicate amt. in words and xx/100 Dollars) for the performance of all work associated with the Contractor's Base Bid.
- 3.2 The University may, at its sole discretion, during the life of the contract, award the following alternates, at the amounts indicated (If section 3.2 is not used, delete all text and enter "Deleted").

	Description	Amount
Alternate #1		
Alternate #2		
Alternate #3		

- 3.3 In the event additional work becomes necessary, the following unit prices will apply (If section 3.3 is not used, delete all text and enter "Deleted"):

Work Item	Unit Price
1.	
2.	
3.	

Article 4 - The Contract Documents

- 4.1 The Contract Documents shall consist of this Agreement, the drawings and specifications as listed in Article 17, the General Conditions of the Contract for Construction as defined by AIA Document A201 1970 Edition, except as otherwise provided herein, and Wayne State University's Supplementary General Conditions 1997 Edition.
- 4.2 For any inconsistencies found among or between these Contract Documents, the language contained in this Agreement shall prevail over all other documents and the Supplementary General Conditions shall prevail over the General Conditions. In the event of a conflict between the Drawings and Specifications, the requirement for the higher quantity and/or higher quality shall prevail.

Article 5 – Examination of Premises

- 5.1 The Contractor acknowledges that the University provided the opportunity for a thorough examination of the project site and its surroundings and that the Contractor knows of no conditions preventing accomplishment of the full scope of work within the time and for the amount specified in this Agreement.
- 5.2 The University will deny all claims for additional time and/or cost for conditions that could have been reasonably discovered during such an examination.

Article 6 - The Architect/Engineer

- 6.1 The Architect/Engineer for this project is:

**DiClemente Siegel Design Inc.
28105 Greenfield Rd.
Southfield, Michigan 48076**

- 6.2 The University will appoint a Project Manager who will be the University's point of contact for all matters of contract administration including, but not limited to, interpretation of documents, defining the scope of work, approving work schedules, and approving contract payments.

Article 7 - Additional Work

- 7.1 The University reserves the right to let other Agreements in connection with this work. The Contractor will afford other Contractors or the University's own workforce reasonable opportunity for the delivery and storage of their material and for the performance of their work and shall properly connect and coordinate its work with theirs.
- 7.2 If any part of the Contractor's work depends for proper execution or results upon the work of another Contractor or the University's own workforce, the Contractor shall inspect and promptly report to the University's Project Manager any defects in such work that render it unsuitable for such proper execution and results. The Contractor's failure to so inspect and report shall constitute an acceptance of the work of others as fit and proper for reception of the Contractor's work and as a waiver of any claim or defense against the University or other contractor which relies in whole or in part upon the contention that such work was unsuitable for proper execution and resolution.

Article 8 – Dispute Resolution

- 8.1 Jurisdiction over all claims, disputes, and other matters in question arising out of or relating to this contract or the breach thereof, shall rest in the Court of Claims of the State of Michigan. No

provision of this agreement may be construed as Wayne State University's consent to submit any claim, dispute or other matter in question for dispute resolution pursuant to any arbitration or mediation process, whether or not provisions for dispute resolution are included in a document which has been incorporated by reference into this agreement. Specifically, all references to Arbitration contained in the General Conditions are superceded by this Article.

- 8.1 In any claim or dispute by the Contractor against the University, which cannot be resolved by negotiation, the Contractor shall submit the dispute in writing for an administrative decision by the University's Vice President for Finance and Administration, within 30 days of the end of negotiations. Any decision of the Vice President shall be made within 45 days of receipt from the Contractor and is final unless it is challenged by the Contractor by filing a lawsuit in the Court of Claims of the State of Michigan within one year of the issuance of the decision. The Contractor agrees that appeal to the Vice President is a condition precedent to filing suit in the Michigan Court of Claims.
- 8.2 For purposes of this section, the "end of negotiations" shall be deemed to have occurred when:
- 8.2.1 Either party informs the other that pursuant to this section, negotiations are at an impasse; or
- 8.3.2 The Contractor submits the dispute in writing to the Vice President.
- 8.4 Unless otherwise agreed by the University in writing, and notwithstanding any other rights or obligations of either of the parties under any Contract Documents or Agreement, the Contractor shall continue with the performance of its services and duties during the pendency of any negotiations or proceedings to resolve any claim or dispute, and the University shall continue to make payments in accordance with the Contract Documents; however, the University shall not be required or obligated to make payments on or against any such claims or disputes during the pendency of any proceeding to resolve such claims or disputes.

Article 9 - Termination for Convenience

- 9.1 Upon thirty days written notice to the Contractor, the University may, without cause and without prejudice to any other right or remedy of the University, elect to terminate the contract. In such case, the Contractor shall only be paid (without duplication of any items), using a Close Out Change Order, for the following:
- 9.1.1 For completed and acceptable work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
- 9.1.2 For expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted work, including fair and reasonable sums for overhead and profit on such expenses.
- 9.2 The Contractor shall not be paid on account of loss of anticipated profits or revenue, delay or disruption, or other economic loss arising out of or resulting from such termination. For purposes of this section, "fair and reasonable sums for overhead and profit" shall be determined by reference to Michigan law, without reference to principles used for such determinations in

arbitration.

Article 10 - Progress Payments

- 10.1 On or before the 20th day of each month, the Contractor shall submit a written application for payment, using form AIA G702, to the Architect/Engineer and the University's Project Manager for review. The Architect/Engineer shall have ten (10) calendar days to accept or reject the Contractor's application for payment. Acceptable applications for payment shall then be submitted to the University for payment of authorized amount(s) within thirty (30) calendar days of receipt by the University's Project Manager.
- 10.2 The application for payment shall contain a full schedule of values organized and sorted by subcontractor, by Construction Specifications Institute standard work categories, or in another format acceptable to the University.
- 10.3 Monthly progress payments shall show the percentage of work installed as of the date of the application, less amount previously installed and the amount due for the application period. The Contractor shall deduct a 10% retainage from the balance due for each progress payment and indicate the net amount due on each application.
- 10.4 When 50% of the work associated with this Agreement is installed, the Contractor shall not deduct additional retainage from the balance due from the University. When substantial completion is achieved and acknowledged by the Architect/Engineer, the Contractor and the University in writing, the University shall remit to the Contractor all but 2% of the retainage. The remaining 2% shall be retained by the University until the final payment is authorized and remitted to the Contractor.

Article 11 - Acceptance and Final Payments

- 11.1 Final payment shall be due thirty (30) days after the completion of the work, including all punch list items, provided the work is fully completed and the Agreement fully performed.
- 11.2 Upon receipt of written notice that the work is ready for final inspection and acceptance, the Architect/Engineer shall promptly inspect the work. When the Architect/Engineer concludes that the work is acceptable and the Agreement to be fully performed, the Architect/Engineer shall promptly issue a final certificate with an original signature, stating that the work provided is complete and acceptable and that the entire remaining balance found to be due the Contractor shall be remitted by the University once the final application for payment is received.
- 11.3 If, after the work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor, and the Architect/Engineer so certifies, the University shall, upon certificate of the Architect/Engineer, and without terminating the Contract, make payments of the balance due for that portion of the work fully completed and accepted. Such payments shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

Article 12 - Non-Discrimination

- 12.1 The Contractor agrees that it will not discriminate against any employee or applicant for employment, to be employed in the performance of this Agreement, 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, sex, age, national origin, or ancestry. Breach of this covenant may be regarded as material breach of this Agreement.

- 12.2 The Contractor further agrees that it will, in all subcontracts relating to the performance of the work under this Agreement, provide in its subcontracts that the subcontractor will not discriminate against any employee or applicant for employment, to be employed in the performance of such contract, with respect to hire, tenure, terms, conditions or privileges of employment, or any matter directly or indirectly related to employment because of race, sex, age, color, religion, national origin or ancestry. Breach of this covenant may also be regarded as a material breach of this Agreement.

Article 13 – Project Labor

- 13.1 The Contractor has been advised of, and accepts the Wayne State University Board of Governors "Policy on Project Labor Agreements," a copy of which is appended hereto as Exhibit B as a material term of this contract, and agrees to comply with said policy and execute Project Labor Agreements (PLA) accordingly.
- 13.2 The Contractor and each subcontractor shall keep an accurate record showing the name and job classification of and the actual benefits and wages paid to each laborer and / or construction mechanic employed in connection with this contract. The Contractor and each subcontractor shall provide certified payroll records to the University's representatives with each and every payment application for work effort associated with the preceeding month.
- 13.3 If a Contractor or subcontractor fails to comply with the Wayne State University Board of Governors "Policy on Project Labor Agreements," and does not cure such failure within ten (10) days after notice to do so by the University, the University shall have the right, at its option, to do any or all of the following:
- 13.3.1 Withhold all or any portion of payments due the Contractor as may be considered necessary by the University to pay laborers and construction mechanics the difference between the rates of wages and fringe benefits required by this Agreement and the actual wage and fringe benefits paid.
- 13.3.2 Terminate part or all of this Agreement or any sub-agreement and proceed to complete the Agreement or sub-agreement by separate agreement with another Contractor or otherwise, in which case the Contractor and its sureties shall be liable to the University for any excess costs incurred by the University.
- 13.4 The Contractor shall include terms identical or substantially similar to this section in any agreement or sub agreement pertaining to the project.

Article 14 - Save Harmless

- 14.1 The Contractor shall indemnify, defend and hold harmless the University, its agents and employees from any and all loss, damage, claims, and causes of action whatsoever, including all costs, expenses and attorneys' fees arising out of Contractor's performance of obligations under the terms and conditions of this agreement. Such responsibility shall not be construed as liability for damage caused by or resulting from the negligence of the University, its agents other than the Contractor, or its employees.

Article 15 - Liquidated Damages

- 15.1 It is understood and agreed that, if the project is not completed within the time specified in the

Agreement plus any extension of time allowed pursuant thereto, the actual damages sustained by the University because of any such delay will be uncertain and difficult to ascertain, and it is agreed that the reasonable foreseeable value of the use of said project by the University would be the sum of **\$250.00, One Hundred Dollars per day**. Therefore, the Contractor shall pay as liquidated damages to the University the sum of **\$250.00, One Hundred Dollars per day** for each day's delay in substantially completing said project beyond the time specified in this Agreement and any extensions of time allowed there under.

Article 16- Interpretation

- 16.1 This Agreement shall be interpreted and construed according to the laws of the State of Michigan.
- 16.2 If one part of this Agreement is found to be void by legal or legislative action, the remainder of the contract remains in full effect.

Article 17 - Drawings and Specifications

- 17.1 The Technical Specifications dated **June 18, 2013**, and the following List of Drawings represent the scope of work as defined in the Contract Documents from Article 4.

DRAWINGS

Drawing No.	Description
-------------	-------------

Sample

IN WITNESS WHEREOF the parties to these presents have hereunto set their hands as of the day and year first written above.

Signed, sealed and delivered
in the presence of:

CONTRACTOR'S NAME GOES HERE

By _____
Signature

Please print name here

Date signed

Title

Witness

**THE BOARD OF GOVERNORS of
WAYNE STATE UNIVERSITY**

By _____
Richard J. Nork, Vice President for
Finance and Facilities

Date signed

Form Contract Approved by OGC 5/98

FORM OF GUARANTEE**PROJECT:** Chatsworth Fire Alarm Panel**OWNER:** BOARD OF GOVERNORS, WAYNE STATE UNIVERSITY**CONTRACTOR:** _____**DATE:** _____

Know all men by these presents that, in consideration of my (our) having been awarded the Contract or Subcontract for complete furnishing and installation of:

Chatsworth Fire Alarm Panel (136-195280)**For: Board of Governors, Wayne State University**

In conformity with drawings and specifications prepared by Architect or Engineer, **DiClemente Siegel Design Inc.**, and known as the buildings indicated above, I (we) do hereby agree that, should I (we) be notified that the said work has proved faulty, etc., that I (we) will return to the buildings within three (3) working days of the receipt of such notice, and will furnish the necessary labor and material to repair such work to the satisfaction of the Owner and without cost to the Owner.

The Agreement shall remain in full force and effect **FOR A ONE YEAR PERIOD (DATE TBD)**

WITNESS:signed: _____
Subcontractor

by: _____

address: _____

city/state/zip: _____

signed: _____
General Contractor

by: _____

(THIS FORM TO BE FILED IN DUPLICATE.)

GENERAL CONDITIONS (Revised 10-2009)

- A. Although AIA Document A201 - Twelfth Edition (April 1970) - "General Conditions of the Contract for Construction" is not bound herein, it forms a part of these construction documents.
- B. A reference copy of AIA Document A201 - Twelfth Edition (April 1970) - "General Conditions of the Contract for Construction" is on file at the following location:

Wayne State University
Finance & Facilities Management
Purchasing Department
Academic / Administrative Services Building
5700 Cass Avenue
Detroit Michigan 48202

**SUPPLEMENTARY GENERAL CONDITIONS
OF
THE CONTRACT FOR CONSTRUCTION**

**Facilities Planning & Management - Design & Construction Services
Wayne State University**

WSU SUPPLEMENTARY GENERAL CONDITIONS
OF THE
CONTRACT FOR CONSTRUCTION

NOTE: The following items related to A.I.A. General Conditions, A.I.A. Document A-201 - Twelfth Edition (April 1970), by specific number being amended to. These items, as amendments, shall have precedence over the article being amended.

ARTICLE 1 - CONTRACT DOCUMENTS

1.1 DEFINITIONS

1.1.5 The Agreement

The Agreement executed by the Contractor and the Owner.

1.2 EXECUTION, CORRELATION, INTENT, AND INTERPRETATIONS

1.2.6 "General Conditions and "Supplementary General Conditions" apply with equal force to all Contractors, Subcontractors work, and extra work required under this Contract.

1.2.7 Precedence of Drawings and Specifications.
The Agreement has precedence over WSU Supplementary General Conditions.

WSU Supplementary General Conditions have precedence over A.I.A. A-201 General Conditions of the Contract.

Specifications have precedence over drawings. Full-size drawings have precedence over scale drawings. Large-scale plans and details have precedence over small-scale plans and details. Figured dimensions have precedence over plans and elevations.

ARTICLE 2 - ARCHITECT

2.1 DEFINITION

2.1.1.1 The term Architect or Architect/Engineer as used in these specifications refers to Facilities Planning and Management - Design Services, and/or Consulting Architect/Engineer.

2.2 ADMINISTRATION OF THE CONTRACT

2.2.16 The Architect will assign Field Representatives to make periodic visits to the project for the purpose of assisting the Architect in carrying out his field responsibilities at the site. The duties, responsibilities and limitations of authority of any such Field Representative shall be as follows:

- a. Explain Contract Documents: Assist the Contractor via the Contractor's Superintendent to understand the intent of the Contract Documents.
- b. Observations: Conduct on-site observations and spot checks of the work in progress as a basis for determining conformance of the work, material, and equipment with the Contract Documents.

- c. Additional Information: Obtain from the Architect, additional details or information, if and when required, at the job site for proper execution of the work.
- d. Modifications: Consider and evaluate suggestions or modifications that may be submitted by the Contractor and report them with recommendations to the Architect for final decision.
- e. Construction Schedule and Completion: Be alert to the completion, and report same to the Architect. When the construction work has been completed in accordance with the Contract Documents, advise the Architect that the work is ready for general inspection and acceptance.
- f. Job Conferences: Attend and report to the Architect on all required conferences held at the job site.
- g. Observe Tests: See that tests which are required by the Contract Documents are actually conducted; observed, record and report to the Architect all details relative to the test procedures; and advise the architect's office in advance of the schedules of tests.
- h. Inspection by Others: If inspectors, representing local, state or federal agencies having jurisdiction over the project, visit the job site, accompany such inspectors during their trips through the project, record the outcome of these inspections, and report same to the Architect's office.
- i. Shop Drawings: Do not permit the installation of any materials and equipment for which shop drawings are required unless such drawings have been duly approved and issued by the Architect.
- j. Contractor's Requisitions for Payment: Review and make recommendations to the Architect for disposition.
- k. List of Items for Correction: After substantial completion, make a list of items for correction before final inspection and check each item as it is corrected.
- l. Owner's Occupancy of the Building: If the Owner occupies (to any degree) the building prior to actual completion of the work by the Contractor, be especially alert to possibilities of claims for damage to completed work prior to the acceptance of the building.
- m. Owner Existing Operation: In the case of additions to or Demolitions of an existing facility, which must be maintained as an operational unit, be alert to conditions on the job site which may have an effect on the Owner's existing operation.
- n. Limitations of Authority: Do not become involved in any of the following areas of responsibility unless specific exceptions are established by written instructions issued by the Architect.
 - aa. Do not authorize deviations from the Contract Documents.
 - bb. Avoid conducting any test personally.
 - cc. Do not enter into the area of responsibility of the Contractor's field superintendent.

- dd. Do not expedite job for Contractor unless so instructed by the Architect.
- ee. Do not advise on or issue directions relative to any aspect of the building technique or sequence unless a specific technique or sequence is called for in the Specifications or by written instructions from the Architect.
- ff. Do not approve shop drawings or samples.
- gg. Do not authorize or advise the Owner to occupy the Project, in whole or in part, prior to the final acceptance of the building.
- hh. Do not issue a Certificate for Payment.

ARTICLE 3 - OWNER**3.5 OWNER'S RIGHT TO DO WORK**

- 3.5.1 The Owner may exercise his right, which is hereby acknowledged by the Contractor, to let independent of the Contract for the work herein specified, any other work on the premises even if of like character and trades, and the Owner shall not be liable for any damage, loss or expense incurred by the Contractor through the fault of any other Contractor so employed by the Owner. The Contractor acknowledges the necessity of work by others, to be performed at approximately the same time as the work hereunder, and agrees to perform his work in full cooperation with the work of such other trades and/or Contractors, partially or entirely completed, by such other trades and/or Contractors, or by the Owner, when, in the opinion of the Architect, such access or use is necessary for the performance and completion of any portion or all of the work of others or of any work on the site.

3.6 OWNER'S ACCESS AND PARTIAL OCCUPANCY

- 3.6.1 The Owner shall have access to the work at all times, and at his election, may from time to time (prior to the stipulated contract completion date) occupy any of the units or parts of the project as the work in connection therewith is complete to such a degree as will, in the opinion of the Owner, permit their temporary or permanent use. The Owner will, prior to any such partial occupancy, give notice to the Contractor thereof and such occupancy shall be upon the following terms:
- a. Such occupancy shall not constitute an acceptance of work not performed in accordance with the Contract nor shall such occupancy relieve the Contractor of liability to perform any work by the Contract by not complete at the time of occupancy.
 - b. Except as otherwise provided by an agreement at the time of such partial occupancy, the Contractor shall be relieved of all maintenance costs on units or parts so occupied.
 - c. The Contractor shall not be responsible for wear and tear or damage resulting from partial occupancy.
 - d. The Owner shall assume risk of loss with respect to any unit or part so occupied.
 - e. The Contractor shall, if required by the Owner, furnish heat, light, water, or other such services to the units or parts occupied and the Owner shall make proper remuneration therefore to the Contractor.

- 3.6.2 The Contractor agrees that the Owner shall have the right, after seven (7) days' written notice to the Contractor, to place and install as much equipment and machinery during the progress of the work as is possible before the completion of the various parts of the work; and further agrees that such placing and installation of equipment shall not in any way evidence the completion of the work or any portion thereof, nor signify the Owner's acceptance of the work or any portion thereof. Should the Owner place or install such equipment and machinery with his own forces he shall be responsible for any damage to work of the Contractor caused by the Owner's work or workmen. Should the Owner have such placement or installation performed by another Contractor, then the Owner shall require said Contractor to be responsible for all such damage caused by his work, his workers, or his subcontractors.

ARTICLE 4 - CONTRACTOR

4.4 LABOR AND MATERIALS

- 4.4.3 All materials shall be so delivered, stored and handled to prevent the inclusion of foreign materials and the damage of materials by water or breakage. Packaged materials shall be delivered and stored in original packages until ready for use. Packages or materials showing evidence of water or other damage shall be rejected. All materials shall be of the respective qualities specified herein.
- 4.4.4 The Contractor shall be responsible for the proper care and protection of all his materials, equipment, etc., delivered at the site. Building materials, equipment, etc., may be stored on the premises subject to the approval of the Architect.
- 4.4.5 To insure timely availability of critical materials in case of national emergency, the Contractor may order his subcontractors to proceed with fabrication of the same earlier than required by normal sequence of construction. In the event storage facilities are not available on the site or at the source of fabrication, the Owner will endeavor to provide such storage space as may be available to care for same. Where this is necessary, the Contractor shall be paid for all stored material on the Owner's property or on the properties approved by the Owner upon approval of certified invoices. It shall be the Contractor's obligation to pay for all handling costs and damage to this material. The Contractor shall protect this property against damage.

4.6 TAXES

- 4.6.1 The Bidder shall include in his proposal and make payment of all Federal, State, County and Municipal taxes including Michigan State Sales and Use Taxes, now in force or which may be enacted during the progress and completion of the work covered.

4.7 PERMITS, FEES AND NOTICES

- 4.7.3 The Contractor shall pay highway or DPW fees for damages to sidewalks, streets, or other public property or to any public utilities.
- 4.7.4 Permits and licenses of a temporary nature necessary for the execution of the work shall be secured and paid for by the Contractor.

4.7.5 **Except for the General Building Permit (which is not required), the Contractor shall secure and pay for all other required permits, including the following:**

Electrical	-	State of Michigan
Plumbing	-	State of Michigan
Mechanical	-	State of Michigan
Elevator	-	City of Detroit

4.7.6 The Contractor shall secure certificates of inspection and of occupancy that may be required by authorities having jurisdiction over the work. These certificates shall be delivered to the Architect upon completion of the work.

4.9 SUPERINTENDENT

4.9.2 The Contractor shall give sufficient supervision to the work, using his best skill and attention. He shall carefully study and compare all drawings, specifications, and other instructions, and shall at once report to the Architect any error, inconsistency, or omission which he may discover, but he shall not be held responsible for their existence or discovery.

4.9.3 The Contractor's superintendent shall periodically inspect the entire project to make certain that all of the stipulations of all of the articles of the General Conditions are being observed.

4.12 DRAWINGS AND SPECIFICATIONS AT THE SITE

4.12.1.1 Refer to Paragraph 4.12.1, of A.I.A. General Conditions of the Contract for Construction. Modify the last sentence of this paragraph to read:

"The Drawings, marked to record all changes made during construction, shall be incorporated in the Contractor's 'Informational Package'."

4.12.2 As a basic and interim step for the fulfillment of the "Informational Package", accurate records of all non-structural underground and concealed work shall be kept, including, but not limited to, all piping, conduit, equipment, and drainage and tunnel work. In addition, such records shall be available for review during various steps of the project.

4.13 SHOP DRAWINGS AND SAMPLES

4.13.9 Immediately before and as a condition of substantial completion, the Contractor shall provide the Owner an "Informational Package" and instructional sessions on the operation, maintenance, and service of the facility. The "Informational Package" shall include:

1. One (1) set of transparency (sepia) of the approved shop drawings and descriptive material submitted during construction. Any shop documents unobtainable in sepia shall be supplied in three (3) sets.
2. One (1) set of transparency (sepia) of constructional shop drawings with all installation revisions incorporated to reflect the as-built condition. Examples of constructional shop drawings are dimensioned conduit, piping and ductwork layout drawings.

3. Three (3) sets of instructional manuals on the installation, operation, maintenance and service of equipment and systems, including parts lists.

Examples of Specific Information Required:

1. Electrical
 - a. Conduit layout of light, power, and special systems, indicating dimensionally the locations and size of runs; circuit grouping and conductor size and number in conduit runs.
 - b. System description and elementary diagrams, connection and interconnection diagrams, and device internal diagrams.
2. Mechanical
 - a. Piping and ductwork layout indicating dimensionally the location and size of the runs.
 - b. Description and diagrams of control systems.

Following the submittal of the "Informational Package", the Contractor shall schedule and provide, at the Owner's convenience, instructional sessions for Owner's personnel to acquaint them with the operation, maintenance, and service of the system.

3. Elevators
 - a. Elementary diagrams and description of sequence of operation of the system control components, connection and interconnection diagrams, and device internal diagrams.

ARTICLE 5 - SUBCONTRACTORS

- 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK
- 5.2.3 Delete Article 5.2.3 in its entirety.
- 5.2.4 Delete Article 5.2.4 in its entirety.

ARTICLE 7 - MISCELLANEOUS PROVISIONS (Revised 6-13-2011)

- 7.5 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND
- 7.5.1 The successful Bidder will be required to furnish a Performance Bond and Labor and Material Payment bond in an amount equal to 100% of the contract award amount, and include such cost in the Proposal, complying with the laws of the State of Michigan. The graduated formula no longer applies.
 - A. Performance Bond and Labor and Material Payment Bond shall be from a surety company acceptable to the Owner and made payable as follows:
 - (1) A Labor and Material Payment bond for 100% of the contract award amount to the Board of Governors of Wayne State University, and guaranteeing the payment of all subcontractors and all indebtedness incurred for labor, materials,

or any cause whatsoever on account of the Contractor in accordance with the laws of the State of Michigan relating to such bonds.

- (2) A Performance bond for 100% of the contract award amount to the Board of Governors of Wayne State University to guarantee and insure the completion of work according to the Contract.

B. The only acceptable Performance Bond shall be the AIA A312 – 2010.

- C. The Contractor shall include with his bid evidence of his ability to obtain a Performance Bond in the amount of 100% of the bid amount, and in accordance with the terms and conditions outlined in this section, Such evidence shall be project specific and shall be submitted on a form provided by the Surety or Agent thereof.

7.7 ROYALTIES AND PATENTS

- 7.7.1 The Contractor hereby agrees to indemnify, protect and save harmless the Architect and the Owner from and against any and all liability, loss or damage, and to reimburse the Owner and the Architect for any expenses, including legal fees and disbursements to which the Owner or the Architect may be put because of claims of litigation on account of infringement or alleged infringement of any letters patent or patent rights by reason of the work or materials, equipment, or other items used by the Contractor in its performance.

7.9 INTEREST

- 7.9.1 Delete Article 7.9 in its entirety.

ARTICLE 8 - TIME

8.1 DEFINITIONS

- 8.1.3 The Date of Substantial Completion of the Work is the Date certified by the Architect when construction of the entire work is sufficiently complete, in accordance with the Contract Documents, so the Owner may occupy the Work for the use for which it is intended. It is the beginning date for the guarantees on all the Project Work.

8.3.5 LIQUIDATED DAMAGES

It is understood that if said Contract is not completed within the time specified in the Contract plus any extension of time thereto, the Contractor shall pay Liquidated Damages to the Owner as set forth in Article 11 of the Agreement between Contractor and Owner for Construction.

ARTICLE 9 - PAYMENT AND COMPLETION

9.3 PROGRESS PAYMENTS

- 9.3.1 On or before the 20th day of each month, the Contractor shall submit to the Architect on the Owner's Standard Form, a written application for payment showing the proportionate value of the work installed to date from which shall be deducted, a reserve of 10% and all previous payments, and the balance of the amount as approved by the Architect shall be due and payable to the Contractor on or about the 15th day of the succeeding month.

- 9.3.2.2 No payments will be made because of materials or equipment stored off the site, except as provided for in Subparagraph 4.4.5 of the Supplementary General Conditions or other

9.6 special cases the Owner may approve.
FAILURE OF PAYMENT

9.6.1 Delete Article 9.6 in its entirety.

ARTICLE 11 - INSURANCE (Revised 3-22-2012)

11.1 CONTRACTOR'S LIABILITY INSURANCE

11.1.2 The insurance required by Subparagraph 11.1.1 shall be written for not less than any limits of liability specified herein, or required by law, whichever is greater, and shall include contractual liability insurance as applicable to the Contractor's obligations under Paragraph 4.18.

During the life of the Contract, the Contractor shall maintain the following types of insurance:

A. General Requirements

<u>Type of Insurance</u>	<u>Minimum Requirement</u>
1. Comprehensive General Liability	Bodily Injury \$ 500,000 each person \$1,000,000 aggregate Property Damage \$ 500,000 each occurrence \$1,000,000 aggregate <u>or</u> \$2,000,000 combined single limit (CSL)
2. Fire Legal Liability	\$ 100,000
3. Comprehensive Automobile Liability (including Hired and non-owned vehicles)	Bodily Injury \$ 500,000 each person \$1,000,000 each accident Property Damage \$ 500,000 each accident <u>or</u> \$2,000,000 combined single limit (CSL)
4. Workers' Compensation (Employer's Liability)	Statutory - Michigan \$100,000
5. Property - All Risk	In an amount sufficient to cover the total value of the contractor's property in the care, custody or control of WSU.

B. Maximum Acceptable Deductibles

<u>Type of Insurance</u>	<u>Maximum Deductible</u>
Comprehensive General Liability	\$5,000
Fire Legal Liability	\$5,000
Comprehensive Automobile Liability	-0-
Workers' Compensation	-0-
Property - All Risk	\$ 500

11.1.3 The Board of Governors, Wayne State University, shall be named as an additional insured but only with respect to accidents arising out of the performance of said contract. The contractor shall prepare a certificate of insurance which shall name the "Office of Risk Management; 5700 Cass Avenue" as the Wayne State University certificate holder.

- 11.1.3.1 The Contractor shall either 1) require each of his Subcontractors to procure and to maintain during the life of his subcontract, Subcontractors' Comprehensive General Liability, Automobile Liability and Property Damage Liability Insurance of the type and in the same amounts as specified in the Subparagraph, or 2) insure the activity of his subcontractors in his own policy.

11.2 OWNER'S LIABILITY INSURANCE

Delete Article 11.2 in its entirety.

11.3 PROPERTY INSURANCE

Delete Article 11.3 in its entirety and replace with the following:

- 11.3.1 The Contractor shall purchase and maintain property insurance upon the entire work at the site to the full insurable value thereof. This insurance shall include the interests of the Owner, the Contractor, Subcontractors, and sub-subcontractors in the work and shall insure against the perils of Fire, Extended Coverage, Vandalism, and Malicious Mischief.

- 11.3.2 The Owner and Contractor waive all rights against each other for damages caused by fires or other perils to the extent covered by insurance provided under Subparagraph 11.3.1. The Contractor shall require similar waivers by Subcontractors and sub-subcontractors in accordance with Clause 5.3.1.5.

- 11.3.3 Insurance must be issued by an insurance company with an "A rating as denoted in the AM Best Key Rating Guide".

ARTICLE 12 - CHANGES IN THE WORK

12.1 CHANGE ORDERS

- 12.1.8 Percentage markups in pricing under Subparagraphs 12.1.3.1, 12.1.3.3, and 1.2.4 shall be as limited in the Contract Documents. Unit price of Subparagraph 12.1.3.2 shall represent total unit cost to the Owner and shall include the Contractor's markup for overhead and profit.

ARTICLE 14 - TERMINATION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

- 14.1.1 If the work is stopped for a period of thirty days under any order of any court or other public authority having jurisdiction, or as a result of any act of government, such as a declaration of a national emergency making materials unavailable, through no act or fault of the contract or a subcontractor or their agents or employees or other persons performing any of the Work under a contract with the contractor, then the contractor may, upon seven days' written notice to the Owner and the Architect, terminate the contract and recover from the Owner payment for all Work executed and for any proven loss sustained upon any materials, equipment, tools, construction equipment, and machinery, including reasonable profit and damages.

ARTICLE 15 - ADDITIONAL CONDITIONS

15.1 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- 15.1.1 Whenever a material, article, or piece of equipment is identified on the Drawings or in the Specifications by reference to manufacturers' or vendors' names, trade names, catalog

numbers, or the like, it is so identified for the purpose of establishing a standard, and any material, article, or piece of equipment of other manufacturers or vendors, which will perform adequately the duties imposed by the general design will be considered equally acceptable provided the material, article, or piece of equipment so proposed is, in the opinion of the Architect, of equal substance, appearance, and function. It shall not be purchased or installed by the Contractor without the Architect's written approval.

15.2 NON-DISCRIMINATION PROVISION AND WAGE AND HOUR ACT

15.2.1 During the performance of this contract, the Contractor agrees as follows:

15.2.1.1 The Contractor shall not discriminate against any employee or applicant for employment because of sex, race, creed, color, age, or national origin. The Contractor will take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their sex, race, age, creed, color, or national origin.

15.2.1.2 Such action shall include but not be limited to, the following: employment; upgrading; demotion; or transfer; recruitment or recruitment advertising; layoff or terminations; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this non-discrimination clause.

15.2.1.3 The Contractor will, in all solicitations, or advertisements for employees, placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to sex, race, creed, color, age or national origin.

15.2.1.4 The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice advising the labor union or worker's representative of the Contractor's commitments under Section 202 of Executive Order No. 11246 of October 27, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

15.2.1.5 The Contractor will comply with all provisions of the Executive Order No. 11246 of October 27, 1965, and of the rules, regulations and relevant orders of the Secretary of Labor or other government agency or authority having jurisdiction.

15.2.1.6 The Contractor will furnish all information and reports required by Executive Order No. 11246 of October 27, 1965, and by the rules, regulations, and orders of the Secretary of Labor or other government agency or authority having jurisdiction, and will permit access to his books, records, and accounts by the administrative agency and the Secretary of Labor for the purposes of investigation to ascertain compliance with such rules, regulations and orders.

15.2.1.7 In the event of the Contractor's noncompliance with the non-discrimination clauses of this contract, or with any of the said rules, regulations, or orders, this Contract may be canceled, terminated or suspended in whole or in part, and the Contractor may be declared ineligible for further University contracts or federally-assisted contracts in accordance with procedure authorized in Executive Order No. 11246 of October 27, 1965, or by rule, regulation, or order of the Secretary of Labor or other government agency or authority having jurisdiction.

15.2.1.8 The Contractor will include in the provisions of Subparagraph 15.2.1.1 through 15.2.1.8 in

every subcontract or purchase order unless exempted by rules, regulations or orders of the President's Committee on Equal Employment Opportunity issued pursuant to Section 204 of Executive Order No. 11246 of September 14, 1965, so that provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event the Contractor becomes involved as a result of such direction by the administering agency, the Contractor may request the United States to enter into such litigation to protect the interest of the United States.

15.3 COMPLIANCE WITH COPELAND ANTI-KICKBACK ACT AND REGULATIONS

15.3.1 The Contractor shall comply with the Copeland Anti-Kickback Act and Regulations of the Secretary of Labor (29CFR, Part 3) which are herein incorporated by reference.

15.4 PROJECT LABOR AGREEMENTS

15.4.1 The Contractor has been advised of, and accepts the Wayne State University Board of Governors "Policy on Project Labor Agreements," a copy of which is appended hereto as Exhibit B as a material term of this contract, and agrees to comply with said policy and execute Project Labor Agreements (PLA) accordingly.

15.4.2 The Contractor and each subcontractor shall keep an accurate record showing the name and job classification of and the actual benefits and wages paid to each laborer and / or construction mechanic employed in connection with this contract. The Contractor and each subcontractor shall provide certified payroll records to the University's representatives with each and every payment application for work effort associated with the preceeding month.

15.4.3 If a Contractor or subcontractor fails to comply with the Wayne State University Board of Governors "Policy on Project Labor Agreements," and does not cure such failure within ten (10) days after notice to do so by the University, the University shall have the right, at its option, to do any or all of the following:

15.4.3.1 Withhold all or any portion of payments due the Contractor as may be considered necessary by the University to pay laborers and construction mechanics the difference between the rates of wages and fringe benefits required by this Agreement and the actual wage and fringe benefits paid.

15.4.3.2 Terminate part or all of this Agreement or any sub-agreement and proceed to complete the Agreement or sub-agreement by separate agreement with another Contractor or otherwise, in which case the Contractor and its sureties shall be liable to the University for any excess costs incurred by the University.

15.4.4 The Contractor shall include terms identical or substantially similar to this section in any agreement or sub agreement pertaining to the project.

DRAWINGS

The Technical Specifications dated **June 18, 2013**, and the following List of Drawings represent the scope of work as defined in the Contract Documents from Article 4.

DRAWINGS

Drawing No.	Description
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Posted to the web-site by disciplines

GENERAL REQUIREMENTS**GENERAL****A. CONTRACTOR'S RESPONSIBILITY**

It is not the responsibility of the Architect/Engineer or Owner's Representative to notify the Contractor or subcontractors when to commence, to cease, or to resume work; nor in any way to superintend so as to relieve the Contractor of responsibility or of any consequences of neglect or carelessness by him or his subordinates. All material and labor shall be furnished at times best suited for all Contractors and subcontractors concerned, so that the combined work of all shall be properly and fully completed on the date fixed by the Contract.

The Contractor shall be responsible for all items contained in both the specifications and on the drawings for all trades. He shall be responsible for the proper division of labor according to current labor union agreements regardless of the division of responsibility implied in the contract documents.

B. CODES AND STANDARDS

Reference to standard specifications for workmanship, apparatus, equipment and materials shall conform to the requirements of latest specifications of the organization referenced, i.e., American Society for Testing Materials (ASTM), Underwriters Laboratories, Inc. (UL), American National Standards Institute, Inc. (ANSI), and others so listed in the Technical Specifications.

C. PERMITS, FEES AND NOTICES

See Supplementary General Conditions.

D. MEASUREMENTS

Before proceeding with each Work Item, Contractor shall locate, mark and measure any quantity or each item and report quantities to Engineer. If measured quantities exceed Engineer's estimate, Contractor shall obtain written authorization to proceed from Owner before executing Work required for that Work Item.

Measurement of quantities for individual Work Items will be performed by Contractor and reviewed by Engineer. Coordinate measurements with inspection as required in Section "Coordination."

Cost of Work included in Work Item for quantities as indicated in Contract Documents shall be included in Base Bid.

1. Additions to or deductions from lump sum price for quantities of each Work Item added to or deducted from Work respectively shall be at unit prices indicated in Bid Form and shall constitute payment or deductions in full for all material, equipment, labor, supervision and incidentals necessary to complete Work.

E. CONTRACTOR'S MEASUREMENTS

Before ordering material, preparing Shop Drawings, or doing any work, each Contractor shall verify, at the building, all dimensions which may affect his work. He assumes full responsibility for the accuracy of his figures. No allowance for additional compensation will be considered for minor discrepancies between dimensions on the drawings and actual field dimensions.

F. CONTINUITY OF SERVICE (*Revised 3-26-2012*)

Continuity of all existing services in the building shall be maintained throughout the construction period. Where it is necessary to tie into the existing electrical service, water or waste systems, it shall be done as directed by the Architect/Engineer. This Contract shall also provide temporary lines or bypasses that may be required to maintain continuous service in the building. All utility shutdowns must be approved by the Owners Representative / Project Manager, not less than **7 business days** prior to the event, so that proper notification can be posted..

G. SUBMITTALS

All submittals (except Shop Drawings) and samples required by the Specifications shall be submitted in triplicate unless otherwise specified for a particular item under an individual Specification Section.

Each sample shall be clearly identified on a tag attached, showing the name of the Project Consultant, the project number and title, the names of the Contractor, manufacturer (and supplier if same is not the manufacturer), the brand name or number identification, pattern, color, or finish designation and the location in the work.

Each submittal shall be covered by a transmittal letter, properly identified with the project title and number and a brief description of the item being submitted.

Contractor shall be responsible for all costs of packing, shipping and incidental expenses connected with delivery of the samples to the Project Consultant or other designated address.

If the initial sample is not approved, prepare and submit additional sets until approval is obtained.

Materials supplied or installed which do not conform to the appearance, quality, profile, texture or other determinant of the approval samples will be rejected, and shall be replaced with satisfactory materials at the Contractor's expense.

H. GENERAL/STANDARD ELECTRONIC EQUIPMENT AND INFRASTRUCTURE REQUIREMENTS (*Revised 11-2008*)**1. Compliance with WSU Standards for Communications Infrastructure**

- A. All applicable work, products, materials and methods shall comply with the latest version of the "WSU Standards for Communications Infrastructure" except as where noted.
- B. This document is available at the following website/URL:
<http://networks.wayne.edu/WSU-Communications-Standards.pdf>

2. Automation System Program Code

- A. All automation system uncompiled and compiled program codes, source codes, custom modules, graphical user interface screen shots and any other automation system programming data and material (Program Code) shall be provided to the UNIVERSITY in hard copy and on CD Rom in an unencrypted format acceptable to the UNIVERSITY.

- B. Copyright for the Program Code shall be assigned to the UNIVERSITY for purposes of system maintenance.

PROTECTION OF OCCUPANCY (Revised 3-2006)**A. FIRE PRECAUTIONS**

Take necessary actions to eliminate possible fire hazards and to prevent damage to construction work, building materials, equipment, temporary field offices, storage sheds, and other property.

During the construction, provide the type and quantity of fire extinguishers and fire hose to meet safety and fire prevention practices by National Fire Protection Association (NFPA) Codes and Standards (available at <http://www.nfpa.org/>)

In the event that construction includes "hot work", the contractor shall provide the Owner's Representative with a copy of their hot work policy, procedures, or permit program. No hot work activity (temporary maintenance, renovation, or construction by operation of a gas or electrically powered equipment which produces flames, sparks or heat that is sufficient to start a fire or ignite combustible materials) shall be performed until such documents are provided. During such operations, all highly combustible or flammable materials shall be removed from the immediate working area, and if removal is impossible, same shall be protected with flame retardant shield.

Not more than one-half day's supply of flammable liquids such as gasoline, spray paint and paint solvent shall be brought into the building at any one time. Flammable liquids having a flash point of 100 degrees F. or below which must be brought into the building shall be confined in an Underwriters Laboratories (UL) labeled safety cans. The bulk supply of flammables shall be stored at least 75 feet from the building and other combustible materials. Spigots on drums containing flammable liquids are prohibited on the project site. Drums shall be equipped with approved vented pumps, and be grounded and bonded.

Only a reasonable working supply of combustible building materials shall be located inside the building.

All oil-soaked rags, papers, and other similar combustible materials shall be removed from the building at the close of each day's work, or more often if necessary, and placed in metal containers, with self-closing lids.

Materials and equipment stored in cardboard cartons, wood crates or other combustible containers shall be stored in an orderly manner and accessibly located, fire-fighting equipment of approved types shall be placed in the immediate vicinity of any materials or equipment stored in this type of crate or carton.

No gasoline, benzene, or like flammable materials shall be poured into sewers, manholes, or traps.

All rubbish shall be removed from the site and legally disposed of. Burning of rubbish, waste materials or trash on the site shall not be permitted.

The contractor shall be responsible for the conduct of employees relative to smoking and all smoking shall be in the area designated by the Architect/Engineer.

B. GENERAL SAFETY AND BUILDING PRECAUTIONS

Provide and maintain in good repair barricades, railings, etc., as required by law for the protection of the Public. All exposed material shall be smoothly dressed.

At dangerous points throughout the work environment provide and maintain colored lights or flags in addition to above guardrails.

Isolate Owner's occupied areas from areas where demolition and alteration work will be done, with temporary, dustproof, weatherproof, and fireproof enclosures as conditions may require and as directed by the Architect/Engineer.

Cover and protect furniture, equipment and fixtures to remain from soiling, dust, dirt, or damage when demolition work is performed in rooms or areas from which such items have not been removed.

Protect openings made in the existing roofs, floors, and other construction with weatherproof coverings, barricades, and temporary fire rated partitions to prevent accidents.

Repair any damage done to existing work caused by the construction and removal of temporary partitions, coverings, and barricades.

The Contractor will be held responsible for all breakage or other damage to glass up to the time the work is completed.

Provide protection for existing buildings, interior and exterior, finishes, walls, drives, landscaping, lawns (see below), etc. All damages shall be restored to match existing conditions to the satisfaction of the Architect/Engineer.

The Contractor and Owner will define the anticipated area of lawn damage at the project Pre-Construction Meeting. Whether the lawn is sparse or fully developed, any lawn damaged due to the Contractor's work will be replaced with sod by the University. The University's unit cost of \$10.00 per square yard and landscaping at a rate of 1.5 times the cost of the sod repairs, the full cost of which will be assessed against the Contractor. At the completion of the project, a deductive Change Order reflecting this cost will be issued.

The Contractor is to include an allowance in his bid for this corrective work.

C. INTERFERENCE WITH OWNER'S OPERATIONS

The Owner will be utilizing the Building Facilities to carry on his normal business operation during construction. The Contractor shall schedule performance of the work necessary to complete the project in such a way as to interfere as little as possible with the operation during construction. The Contractor shall schedule performance of the work necessary to complete the project in such a way as to interfere as little as possible with the operation of the Owner.

Work which will interfere with the Owner's occupancy, including interruptions to the Owner's mechanical and electrical services, and essentially noisy operations (such as jackhammering) shall be scheduled in advance. The schedule of alterations shall be approved by the Architect/Engineer and the work shall be done in accordance with the approved schedule.

It is understood that the work is to be carried through to completion with the utmost speed consistent with good workmanship and to meet the construction schedule.

The Contractor shall begin work under the Contract without delay upon receipt of the fully-executed contract and shall substantially complete the project ready for unobstructed occupancy and use of the Owner for the purposes intended within the completion time stated in the contract.

The Contractor shall, immediately upon award of contract, schedule his work and expedite deliveries of materials and performance of subcontractors to maintain the necessary pace to meet the construction schedule.

CONTRACTOR'S REPRESENTATION AND COORDINATION

A. FIELD SUPERINTENDENT

Contractor shall assign a full time project manager/superintendent for the duration of the project. This person shall be experienced and qualified in all phases of the work and shall be present at the site during Contractor's working hours. The project manager shall have Contractor's full authority to represent Contractor in all routine operations including payment, changes to the work, and scheduling. Contractor shall not re-assign this individual without prior written permission of the Owner.

B. MEETINGS

When directed by the Architect/Engineer, meetings shall be held for the purpose of coordinating and expediting the work. The invited contractors or subcontractors will be required to have qualified representatives at these meetings, empowered to act in their behalf.

C. COORDINATION

The Contractor shall also provide a staff adequate to coordinate and expedite the work properly and shall at all times maintain competent supervision of its own work and that of its subcontractors to insure compliance with contract requirements.

The Contractor shall be solely responsible for all construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the work under the Contractor.

D. CONSTRUCTION SCHEDULE

The Construction Schedule shall be prepared after the award of contract. Soon after, a pre-construction meeting is held with the Owner and the Architect/Engineer to determine the areas to which the Contractor will be allowed access at any one time.

The Contractor is alerted to the fact that areas in which he will be working will be occupied by students and employees of the University as well as the general public. The Contractor's access, to and from the project site, will be confined to limited areas so as not to unduly disrupt the normal activities of the University.

TEMPORARY FACILITIES

A. GENERAL

The following temporary facilities descriptions represent standard conditions. Verify accuracy with Architect/Engineer at time of bids.

B. CONTRACTOR'S OFFICE

Provide field offices as required. Locate temporary field offices on site where directed by Architect/Engineer.

Appearance and location of field offices shall be approved by the Architect/Engineer.

Provide for all other administrative facilities and storage off the Owner's property.

C. STORAGE OF MATERIALS

All materials shall be stored in areas designated by the Architect/Engineer. All stored materials shall be arranged for the minimum disruption to occupants and to allow full access to and throughout the building. Materials stored outdoors shall be neat and orderly and covered to prevent damage or vandalism.

D. PARKING**1. GENERAL**

University parking regulations will be strictly enforced.

Maintain Owner's parking areas free of dirt and debris resulting from operations under the contract.

2. STANDING AND UNLOADING/LOADING VEHICLES

All Contractors are to call Wayne State University Public Safety at 577-2222, and give at least 24 hours advance notice that they have vehicles that must be at the job site.

Vehicles will be permitted at the project site only as long as the vehicles are needed for loading/unloading, and must be immediately moved upon completion.

All unauthorized and/or unattended standing vehicles will be subject to ticketing and removal by University Police. Towed vehicles may be reclaimed by calling 577-2222, and paying any assessed charges.

3. COMPLIMENTARY PARKING

There is no complimentary parking for Contractor's employee vehicles.

4. WAYNE STATE UNIVERSITY PUBLIC/STUDENT PARKING AREAS

Public Parking, on a first-come first-served basis is available. Contact the office of the One Card System, at 313.577.9513 for information on availability of parking on a contractual basis.

E. TOILET FACILITIES

The Owner's designated existing toilet facilities may be used by workers on the project. Contractor shall maintain such facilities in a neat and sanitary condition.

F. TELEPHONE USE

If required, the Contractor shall provide and pay for a temporary telephone within the building for his use and that of his subcontractors.

No use of the Owner's telephone (except pay telephones) will be permitted.

G. ACCESS DEVICES

The Contractor shall furnish and maintain temporary hoists, ladders, railings, scaffolds, runways, and the like as required for safe, normal access to the permanent construction until the permanent facilities are complete. Each trade shall furnish such additional means of access as may be required for the progress and completion of the work. Such temporary access devices shall meet all applicable local, state, and federal codes and regulations.

H. **HEAT AND VENTILATION**

Provide cold weather protection and temporary heat and ventilation as required during construction to protect the work from freezing and frost damage.

Provide adequate ventilation as required to maintain reasonable interior building air conditions and temperatures, to prevent accumulation of excess moisture, and to remove construction fumes.

Tarpaulins and other materials used for temporary enclosures. Coverings and protection shall be flame-proofed.

I. **WATER SERVICE**

Sources of water are available at the site. The Owner will pay for reasonable amounts of water used for construction purposes.

The Contractor shall provide, at the earliest possible date, temporary connections to the water supply sources and maintain adequate distribution for all construction requirements. The Contractor shall protect sources against damage.

Methods of conveying this water shall be approved by the Architect/Engineer and shall not interfere with the Owner's operations.

J. **ELECTRICAL SERVICES**

All charges for reasonable amounts of electrical power energy used for temporary lighting and power required for this work will be paid by the Owner.

The Contractor shall provide and maintain any temporary electrical lighting and power required for this work. At the completion of the work, all such temporary electrical facilities shall be removed and disposed of by the Contractor.

Temporary lighting and power shall comply with the regulations and requirements of the National Electrical Code

INSPECTIONS AND TESTS

The Architect/Engineer shall at all times have access to the work wherever it is in preparation or in progress and the Contractor shall provide proper facilities for such access and for observation.

No failure of the Architect/Engineer, during the progress of the work, to discover or reject materials or work not in accordance with the Contract Specifications and Drawings shall be deemed an acceptance thereof nor a waiver of defects therein. Likewise, no acceptance or waiver shall be inferred or implied due to payments made to contractor or by partial or entire occupancy of the work, or installation of materials that are not strictly in accordance with the Contract Specifications and Drawings.

Where tests are specifically called for in the Specifications, the Owner shall pay all costs of such tests and engineering services unless otherwise stated in the contract.

Where tests are not specifically called for in the Specifications, but are required by the Architect/Engineer or Consultant, the Owner shall pay all costs of such tests and engineering services unless the tests reveal that the workmanship or materials used by the Contractor are not in conformity with the Drawings, Specifications, and/or approved shop drawings. In such event, the Contractor shall pay for the tests, shall remove all work and materials so failing to conform and replace with work and materials that are in full conformity.

CLEAN-UP

The Contractor shall at all times keep the Owner's premises and the adjoining premises, driveways and streets clean of rubbish caused by the Contractor's operations and at the completion of the work shall remove all the rubbish, all of his tools, equipment, temporary work and surplus materials, from and about the premises, and shall leave the work clean and ready for use. If the contractor does not attend to such cleaning immediately upon request, the Architect/Engineer may cause such cleaning to be done by others and charge the cost of same to the Contractor.

The Contractor will be responsible for all damage from fire that originates in, or is propagated by, accumulations of rubbish or debris.

All rubbish and debris shall be disposed of off the Owner's property in an approved sanitary landfill site. No open burning of debris or rubbish will be permitted. Job site shall be left neat and clean at the completion of each day's operation.

PROJECT CLOSE-OUT

A. RECORD DRAWINGS

At beginning of job, provide one copy of Working Drawings, and record changes, between Working Drawings and "As Built", including changes made by Addenda, Change Orders, Shop Drawings, etc. These shall be kept up to date. Update to indicate make of all mechanical and electrical equipment and fixtures installed. Keep these Record Prints in good condition and available for inspection by the Architect/Engineer.

Upon completion of the job, turn over to the Architect/Engineer Record Prints of Working Drawings showing all job changes.

B. OPERATING AND MAINTENANCE DATA

Prepare and furnish to the Architect/Engineer three (3) bound copies of "Operating and Maintenance Manual" on all equipment installed under this Contract.

Manual shall include copies of all Manufacturers' "Operating and Service Instructions", including Parts List, Control Diagrams, Description of Control Systems, Operating, Electrical Wiring, and any other information needed to understand, operate and maintain the equipment. The names and addresses of all subcontractors shall be included. These instructions shall be custom-prepared for this job -- catalog cuts will **not** be accepted. Equipment shall be cross-referenced to Section of Specifications and to location shown and scheduled on drawings.

Include Test-Adjust-Balance Report in the Manual.

C. FINAL INSPECTION

Secure final inspections from the State of Michigan as soon as the work is completed and immediately submit such Certificates to the Architect/Engineer.

D. GUARANTEES (See Sections 00510 and 01781)

Guarantees on material and labor from the General Contractor and his subcontractors shall be as required in Sections 00510 and 01781.

E. SWORN STATEMENT AND WAIVER OF LIENS (*revised 4-11-2012*)

Prior to final payment, the General Contractor shall provide a Contractor's Sworn Statement and Full Unconditional Waivers of Liens from all subcontractors for material and labor and from all suppliers who provide materials exceeding \$1,000. Sworn Statements and Signed waivers from all Subcontractors must accompany Pay Applications or they will be returned for such documentation prior to approval.

ASBESTOS HAZARD

- A. The contractor shall not start any work in any area that has not been inspected for asbestos by the Owner's Industrial Hygiene Department, or a qualified representative of the Owner, and approval is given for work to be done. If asbestos is found, safety measures as recommended by the Owner's Industrial Hygiene Department, or a qualified representative of the Owner, shall be completed, or approval given for work to be done before work is started. The contractor shall not perform any asbestos removal or containment work under the contract.

KEYS

- A. The Owner shall provide the contractor keys on loan to have access to the various spaces in order to complete the contract. Contractor will sign for and be responsible for each key on loan, returnable to Owner upon completion of the contract. In case of any lost keys, the Owner will back-charge the contract \$250.00 for each core change. In the event that a Contractor wants access to a secured area, he shall give the Owner a minimum 48-hour notice.

SUMMARY OF WORK

SUMMARY OF WORK

PROJECT: Chatsworth Fire Alarm Panel

WSU PROJECT NO. 136-195280

PROJECT MANAGER: Chrystal Camilleri

1. EXAMINATION

The Contractor shall visit the site and become familiar with conditions under which he will be working. Also meet with the project manager and review site access, storage areas, etc.

2. Description of Work – Project includes Expansion of the existing fire suppression, fire alarm system expansion and replacement, new Make –Up Air Handling Units, IT and TV cabling, and interior finishes. Patching and repairs of disturbed surface areas to match existing adjacent surfaces is included. The building is located at

Wayne State University
Chatsworth Tower Apartments, 630 Williams Mall
Detroit, Michigan 48202

SPECIFICATIONS

WAYNE STATE UNIVERSITY

CHATSWORTH TOWER APTS. MISC. BLDG. UPGRADES

DETROIT, MICHIGAN

WSU Project No. 136-195280

DSD Project No. 12-4806.00

Bids – June 18, 2013

SPECIFICATIONS

FOR THE

WAYNE STATE UNIVERSITY

CHATSWORTH TOWER APTS. MISC. BLDG. UPGRADES

AT

DETROIT, MICHIGAN

Prepared by:

DICLEMENTE SIEGEL DESIGN INC.
28105 GREENFIELD ROAD
SOUTHFIELD, MICHIGAN 48076

WSU Project No. 136-195280

DSD Project No. 12-4806.00

Bids – June 18, 2013

TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGES
DIVISION 01 – GENERAL REQUIREMENTS		
012200	UNIT PRICES	012200-1 – 2
012300	ALTERNATES	012300-1 - 2
DIVISION 02 - 10 – ARCHITECTURAL		
024112	PAVEMENT REMOVAL AND DISPOSAL.....	024112-1 – 2
024113	SELECTIVE DEMOLITION.....	024113-1 - 4
024119	SELECTIVE STRUCTURE DEMOLITION	024119-1 - 5
078413	PENETRATION FIRESTOPPING	078413-1 - 5
081113	HOLLOW METAL DOORS AND FRAMES	081113-1 - 7
081433	STILE AND RAIL WOOD DOORS	081433-1 - 2
083113	ACCESS DOORS AND FRAMES	083113-1 - 4
087100	DOOR HARDWARE	087100-1 - 9
092216	NON-STRUCTURAL METAL FRAMING.....	092216-1 - 5
092900	GYPSUM BOARD.....	092900-1 - 3
095113	ACOUSTICAL PANEL CEILINGS	095113-1 - 2
096513	RESILIENT BASE AND ACCESSORIES.....	096513-1 - 3
099123	INTERIOR PAINTING.....	099123-1 - 4
102213	WIRE MESH PARTITIONS.....	102213-1 - 3
DIVISION 21 – FIRE SUPPRESSION		
210500	COMMON WORK RESULTS FOR FIRE SUPPRESSION	210500-1 - 6
210513	COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT	210513-1 - 2
210517	SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING.....	210517-1 - 3
210518	ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING	210518-1 - 2
210548	VIBRATION CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT	210548-1 - 3
211100	WATER-BASED FIRE-SUPPRESSION SYSTEMS.....	211100-1 - 14
TABLE OF CONTENTS		TOC - 1
Bids – June 18, 2013		

211200	FIRE-SUPPRESSION STANDPIPES.....	211200-1 - 13
213113	ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS	213113-1 - 6
213400	PRESSURE-MAINTENANCE PUMPS.....	213400-1 - 4
213900	CONTROLLERS FOR FIRE-PUMP DRIVERS	213900-1 - 6

DIVISION 22 – PLUMBING

220500	COMMON WORK RESULTS FOR PLUMBING.....	220500-1 - 7
220517	SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING	220517-1 - 3
220518	ESCUTCHEONS FOR PLUMBING PIPING.....	220518-1 - 2
220523	GENERAL DUTY VALVES FOR PLUMBING PIPING	220523-1 - 6
220529	HANGERS AND SUPPORTS FOR PLUMBING AND FIRE PROTECTION PIPING AND EQUIPMENT	220529-1 - 8
220553	IDENTIFICATION FOR PLUMBING AND FIRE PROTECTION PIPING AND EQUIPMENT.....	220553-1 - 5
220719	PLUMBING PIPING INSULATION	220719-1 - 15
221113	FACILITY WATER DISTRIBUTION PIPING – FIRE SERVICE MAINS.....	221113-1 - 9
221316	SANITARY WASTE AND VENT PIPING.....	221316-1 - 7
221319	SANITARY WASTE PIPING SPECIALTIES.....	221319-1 - 4

DIVISION 23 – MECHANICAL

230523	GENERAL-DUTY VALVES FOR HVAC PIPING.....	230523-1 - 4
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT	230529-1 - 4
230900	INSTRUMENTATION AND CONTROL FOR HVAC	230900-1 - 3
232213	STEAM AND CONDENSATE HEATING PIPING	232213-1 - 5
232216	STEAM AND CONDENSATE PIPING SPECIALTIES	232216-1 - 4
233113	METAL DUCTS.....	233113-1 – 6
238113	PACKAGED TERMINAL AIR-CONDITIONERS.....	238113-1 - 6
238126	SPLIT-SYSTEM AIR-CONDITIONERS	238126-1 - 5
238236	FINNED-TUBE RADIATION HEATERS.....	238236-1 - 3
238239	CABINET UNIT HEATERS	238239-1 - 3

DIVISION 26 – ELECTRICAL

260100	BASIC ELECTRICAL REQUIREMENTS.....	260100-1 - 8
260500	BASIC ELECTRICAL MATERIALS AND METHODS.....	260500-1 - 6
260519	CABLES AND WIRES	260519-1 - 2
260526	GROUNDING.....	260526-1 - 1
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	260529-1 - 5
260533	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.....	260533-1 - 7
260553	IDENTIFICATION FOR ELECTRICAL SYSETMS	260553-1 - 4
262200	LOW-VOLTAGE TRANSFORMERS	262200-1 - 4
262416	PANELBOARDS	262416-1 - 7
262726	WIRING DEVICES.....	262726-1 - 5
262813	FUSES	262813-1 - 2
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS.....	262816-1 - 4
265100	INTERIOR LIGHTING.....	265100-1 - 6
269500	ELECTRICAL ACCEPTANCE TESTS	269500-1 - 2
269950	WSU PREFERRED MANUFACTURERS LIST	269950-1 - 2

DIVISION 27 – COMMUNICATIONS

270000	COMMUNICATIONS GENERAL.....	270000-1 – 19
270010	WSU STANDARDS FOR COMMUNICATIONS INFRASTRUCTURE.....	1 – 68
270500	COMMON WORK RESULTS FOR COMMUNICATIONS.....	270500-1 - 13

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

283111	DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM	283111-1 – 19
--------	--	---------------

DIVISION 31 – EARTHWORK

311413	STRIPPING AND STOCKPILING.....	311413-1 – 1
312216	SITE EXCAVATING AND GRADING	312216-1 – 2
312316	STRUCTURAL EXCAVATION BACKFILL AND COMPACTION	312316-1 – 3
312333	TRENCHING BACKFILL.....	312333-1 – 5

DIVISION 32 – EXTERIOR IMPROVEMENTS

321921	CONCRETE SIDEWALK	321921-1 – 4
329119	TOPSOIL	329119-1 – 2
329219	SEEDING	329219-1 – 3

DIVISION 33 – UTILITIES

330523	HORIZONTAL DIRECTIONAL BORING	330523-1 - 4
331100	WATER DISTRIBUTION PIPING	331100-1 – 3
331217	GATEWELLS	331217-1 – 3
331219	TAPPING SLEEVE AND GATE.....	331219-1 – 2

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

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

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- C. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Duct mounted smoke detector, including labor and materials, per each.
- B. Unit Price No. 2: Area smoke detector, including labor and materials, per each.
- C. Unit Price No. 3: Fire alarm visual indicating device (strobe), including labor and materials, per each.
- D. Unit Price No. 4: Fire alarm audible indicating device (speaker), including labor and materials, per each.
- E. Unit Price No. 5: Combination speaker/strobe, including labor and materials, per each.

- F. Unit Price No. 6: Firefighter's two-way communication phone jack, including labor and materials, per each.
- G. Unit Price No. 7: Fire alarm monitor and/or control module.
- H. Unit Price No. 8: Ceiling access panels, labor and materials, per each.
- I. Unit Price No. 9: Painting corridor walls, labor and materials, per square foot.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

1. Add Alternate AA-T1
 - a. Bidders shall state the amount to be added to the base bid to furnish and install copper backbone cabling for voice from the basement floor MDF to telecom closets on floors 2 thru 9 and copper horizontal cabling for voice to all new voice outlets on floors 2 thru 9 as indicated in the drawings and specifications.
2. Add Alternate AA-T2
 - a. Bidders shall state the amount to be added to the base bid for the complete removal and disposal of all decommissioned backbone and horizontal cabling for voice (floors 2 thru 9 only), data and CATV that is exposed in rooms, corridors, stairwells, exterior building walls, etc. All decommissioned voice cabling within apartment units shall be considered existing to remain so as not to cause damage to walls and painted surfaces where cabling is exposed, painted and installed along door and baseboard trim to outlets. Decommissioned outlets (e.g. biscuit jacks) to be removed as part of this add alternate. Bidders shall visit the project-site in coordination with WSU C&IT for a mandatory walk-through to verify general conditions.
3. Deduct Alternate DA-T1
 - a. Bidders shall state the amount to be deducted from the base bid to furnish and install the trunk and branch cabling system for CATV as indicated in the drawings and specifications.

END OF SECTION 012300

SECTION 024112 - PAVEMENT REMOVAL AND DISPOSAL

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes requirements for the removal of and disposal of pavement as noted on the drawings.

1.02 REFERENCES

- A. Definition:
1. HMA – Hot Mixed Asphalt surface five (5) inches thick or less overlaying concrete aggregate base.
 2. Conc. – 6" or 8" Concrete Pavement, reinforced or non-reinforced on an aggregate base.

1.03 INFORMATION SUBMITTAL

- A. Data:
1. Submit names of the disposal / dump site to be used. Submit one week before the disposal operation is conducted.
 2. Disposal Documents: Contractor shall provide copies of all manifests, chain of custody, delivery and/or receipts issued for the disposal of site debris.

PART 2 – PRODUCTS – NONE

PART 3 – EXECUTION

3.01 PREPARATION

- A. Site:
1. Designate haul routes for debris removal.
 2. Review truck tire cleaning plan.
- B. Saw-cut pavement/paved surfaces full depth where noted to "save" surfaces.

3.02 LOADING AND HAULING

- A. Inspect haul vehicles for soil adhesion to wheels and under carriage. These soils shall be removed and properly handled by the Contractor before leaving site.
1. No transport vehicles shall be allowed to leave the site which are leaking or spilling materials.
 2. All transport vehicles shall be in strict conformance with all the applicable federal, state and local laws.
- B. Truck-loaded volume shall be determined by the Owner's Representative.

3.03 REMOVAL AND DEMOLITION

- A. Breaking Down and Removing: Remove entirely, or to the limits shown, all structures or portions thereof shown on the plans to be removed, including all attached parts and connections. Do not damage the retained portion of an existing structure.
1. Pavement, Curb, Sidewalk: Remove pavement, curb, gutter, curb and gutter, sidewalk, and similar structures to an existing joint or to a sawed joint. Saw concrete full depth unless otherwise allowed. Do not use a crane and ball pavement breaker. Provide for proper grades and connections.

2. Partially or completely remove all structures, including utility structures, having a least dimension of 12 inches if constructed of masonry or non-reinforced concrete; 8 inches for reinforced concrete structures.

- B. Do not damage the retained portion of an existing structure or new work under construction by removal operations.
Do not use explosives except with the written permission of the Engineer. Such permission does not relieve the Contractor of liability and or responsibility for damages resulting from the use of explosives.

3.04 DISPOSAL

- A. All disposal shall conform to Federal, State and local government regulations.
- B. For non-hazardous contaminated wastes the Contractor shall utilize a State of Michigan approved manifest system so that the waste can be tracked from generation to ultimate disposal. The manifest shall comply with all of the provisions of the transportation and disposal regulations.

3.05 SPILLS

- A. The Contractor is responsible for cleaning up all the leaks, spills from containers and other items on site or off site that occur because of the Contractor's negligence. Immediate containment actions shall be taken as necessary to minimize the effect of any spill or leak. The Contractor shall notify the Engineer and appropriate governmental authorities of the incident. Cleanup shall be in accordance with applicable Federal, State, and local laws and regulations.

3.06 CLEANING / CLOSEOUT

- A. All haul roads shall be bladed and leveled at project completion.

END OF SECTION

SECTION 024113 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes notification submittals and procedure for selective demolition and off-site disposal of material/debris of the Owner's structures as shown on the drawings.
- B. Related Requirements: Submittals Section 01 33 00. Permits Section 01 41 00.

1.01 REFERENCES

- A. Definitions
 1. Remove: Remove and dispose of items shown or scheduled. Discard demolished or removed items .
 2. Remove and Reinstall: Remove items shown; clean, service and otherwise prepare them for reuse; store and protect against damage. Reinstall items in same location or in location shown.
 3. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.
 4. Existing to Remain: Protect construction or items shown to remain against damage during selective demolition operations. When permitted by Engineer, Contractor may elect to remove items to suitable, protected storage location during selective demolition and properly clean and reinstall items in their original locations.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Coordinate with Owner's continuing occupation/use of the existing structure and with Owner's partial use of completed new work.
- B. Scheduling:
 1. Schedule: Submit schedule showing proposed methods and sequence of operations for selective demolition work to Owner's representative for review before commencement of Work.
 2. Arrange selective demolition schedule so as not to interfere with Owner's on-site operations.
 3. Give minimum of 72 hours advance notice to Owner of demolition activities which affect Owner's normal operations and if shutdown of service is necessary during changeover.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Demolition operations shall comply with OSHA and EPA requirements and EPA notification regulations insofar as they apply to demolition work under this Contract.
 2. Comply with hauling and disposal regulations of authorities having jurisdiction.
 3. If hazardous materials are found during demolition operations, comply with applicable paragraphs of General Conditions.

1.04 SITE CONDITIONS

- A. Environmental:
 1. Environmental Requirements: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practicable level. Comply with governing regulations relating to environmental protection. Do not use water when it may create hazardous or objectionable conditions including ice, flooding, and pollution.
 2. Contractor shall take every precaution to prevent spillage of materials being hauled in public streets.

- a. It shall be Contractor's responsibility to immediately clean spillage that may accidentally occur.
- b. Do not burn removed material on or within Project Site.

B. Material Ownership:

1. Demolished materials shall become Contractor's property, except for items or materials shown as Remove and Salvage, or otherwise shown to remain Owner's property. Remove demolished material promptly from Site with further disposition at Contractor's option.
2. Historical artifacts, relics, and similar objects, including but not limited to cornerstones and their contents, commemorative plaques and tablets, antiques, and other articles of historical significance remain property of Owner. Notify Owner's Representative when these items are found and obtain method of removal and salvage from Owner.

PART II – PRODUCTS

2.01 REPAIR MATERIALS

- A. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible. Provide Owner with samples prior to use.

PART III – EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions:

1. Before beginning selective demolition work, inspect areas of Work. Survey existing conditions and correlate with requirements shown to determine extent of selective demolition required.
2. If unanticipated mechanical, electrical, or structural elements conflict with intended function or design, investigate and measure nature and extent of conflicts. Promptly submit detailed written reports to Owner's Representative. Pending receipt of the directive from Owner's Representative, rearrange selective demolition schedule to continue general job progress without delay.

B. Utility Services: The Contractor shall carefully coordinate the work in this Section with all other work.

1. Electrical Disconnection: The Contractor shall verify that on site electrical wiring entering all structures to be demolished or in close enough proximity to be damaged by the demolition operations shall be disconnected and/or de-energized prior to proceeding with demolition operations. The Contractor shall coordinate with the local electrical utility company for any necessary relocation of utilities and be responsible for any associated fees or expenses.
2. Water Disconnection: The Contractor shall verify that on site water lines entering all structures or in close enough proximity to be damaged by the demolition operations shall be disconnected and/or capped prior to proceeding with demolition operations.
3. Sewer Disconnection: The Contractor shall located and bulkhead all sewer connections from the building structure prior to proceeding to demolition. Permits shall be obtained from the City/Township and any damage or removal of sidewalk or curbs shall be repaired.
4. Gas Disconnection: The Contractor shall verify that on site gas lines/mains entering all structures or in close enough proximity to be damaged as a result of the demolition operations shall be disconnected and/or capped prior to proceeding with demolition operations. The Contractor shall coordinate with the local electrical utility company for any necessary relocation of utilities and be responsible for any associated fees or expenses.

3.02 PREPARATION

A. Utilities:

1. Drain pipe or remove, collect and dispose of chemicals, gases, explosives, acids, flammable, or other dangerous materials before proceeding with selective demolition operations.

- B. Site:
1. Provide and ensure free and safe passage of Owner's personnel and general public to and from occupied area around selective demolition areas.
 - a. Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury.
 - b. Build temporary covered passageways required by authorities having jurisdiction.
 2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of demolished structures or elements, or adjacent facilities, or Work to remain.
 3. Cease operations and notify Owner's Representative immediately if safety of structure seems endangered. Take precautions to support structure until determination is made for continuing operations.
 4. Remove protection at completion of Work.

3.03 DEMOLITION

- A. Selective Demolition: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition work above each floor or tier before disturbing supporting members on lower levels.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
- B. Concrete Masonry
1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power-driven impact tools.
 2. Break up and remove concrete slabs and walls, unless otherwise shown to remain.
 3. Demolish foundation walls to a depth of not less than twenty four (24") inches below proposed grade.
 4. Break/fracture/crack interior basement slabs where noted.
- C. Explosives or Burning:
1. Use of explosives or related demolition techniques is prohibited.
 2. Burning of debris/demolished materials is prohibited.

3.04 REPAIR / RESTORATION

- A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.
- B. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.
- C. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
1. Completely fill holes and depressions in existing masonry walls to remain with an approved masonry patching material, applied according to manufacturer's printed recommendations.
 2. Completely fill holes and depressions in concrete floors and walls with an approved epoxy mortar or cement mortar patching material, applied according to manufacturer's recommendation.

- D. Patch and repair floor and wall surfaces in the new space where demolished walls or partitions extend one finished area into another. Provide a flush and even surface of uniform color and appearance.
1. Closely match texture and finish of existing adjacent surface.
 2. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
 3. Where patching smooth painted surfaces, extend final paint coat over entire unbroken surface containing the patch after the surface has received primer and second coat.
 4. Inspect and test patched areas to demonstrate integrity of the installation, where feasible.

3.05 SITE QUALITY CONTROL

- A. The Contractor shall establish and maintain a quality control system for contract requirements and maintain records of its quality control for all operations performed, including, but not limiting to, to following:
1. Electrical, gas and water disconnection verified.
 2. Dust Control.
 3. Noise and vibration control.
 4. Demolition, removal, and cleanup.
 5. Disposal.
 6. Observance of environmental regulations.

3.06 CLEANING AND WASTE

- A. Contractor shall maintain an order of neatness and good housekeeping comparable to that observed by Owner.
1. Keep tools, scaffolding, and other demolition equipment in neat and orderly arrangement.
 2. Remove dirt and debris resulting from Contractor's demolition operations from Site daily. Dirt and debris shall not collect or interfere with Owner's facility operations.
- B. Upon completion of demolition work, remove tools, equipment and demolished materials from Site. Remove protection and leave interior areas broom clean.
1. Change filters on air-handling equipment on completion of selective demolition operations.

END OF SECTION

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at 5221 Gullen Mall, Detroit, Michigan.

1.4 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. Hazardous materials will be removed by Owner before start of the Work.

2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 1. Maintain fire-protection facilities in service during selective demolition operations.

1.5 WARRANTY

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of measured drawings.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Building manager will arrange to shut off indicated services/systems when requested by Contractor with specified advanced notice.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 5. Dispose of demolished items and materials promptly and legally in an EPA approved landfill.
- B. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

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

END OF SECTION 024119

SECTION 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.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. 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.
- C. 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."

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. Hilti, Inc.
 - 2. Nelson Firestop Products.
 - 3. NUCO Inc.
 - 4. 3M Fire Protection Products.
 - 5. USG Corporation.

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-barrier walls and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- D. 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. 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. 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.
- D. 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.

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.

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.

3.4 FIELD QUALITY CONTROL

- A. 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.

3.5 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 Substantial 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.

3.6 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestopping for Metallic Pipes, Conduit, or Tubing:

1. F-Rating: 2 hours.
2. Type of Fill Materials: As required to achieve rating.

C. Firestopping for Electrical Cables:

1. F-Rating: 2 hours.
2. Type of Fill Materials: As required to achieve rating.

D. Firestopping for Miscellaneous Electrical Penetrants:

1. F-Rating: 2 hours.
2. Type of Fill Materials: As required to achieve rating.

END OF SECTION 078413

SECTION 081433 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior fire-rated, stile and rail wood doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For stile and rail wood doors. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and other pertinent data.

PART 2 - PRODUCTS

2.1 INTERIOR FIRE-RATED, STILE AND RAIL WOOD DOORS

- A. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to **NFPA 252**.
 - 1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - 2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- C. Interior Fire-Rated Stile and Rail Wood Doors Fire-rated (90-minute rating) doors complying with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards," and with other requirements specified.
 - 1. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:**
 - a. **Algoma Hardwoods, Inc.**
 - b. **Artistic Doors and Windows, Inc.**
 - c. **Dimension Millworks.**
 - 2. Finish: **Transparent.**

3. Wood Species and Cut for Transparent Finish: **Idaho white, lodgepole, ponderosa, or sugar pine, plain sawed/sliced**
4. Insert provisions here for blueprint-matching doors with architectural woodwork or wood paneling if matching is required. Verify availability of matching for fire-rated doors before inserting requirements.
5. Interior Fire-Rated Door Construction: **1-3/4-inch- (44-mm-)** thick, edged and veneered mineral-core stiles and rails and **1-1/8-inch- (29-mm-)** thick, veneered mineral-core raised panels.
6. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.2 FINISHING

A. Transparent Finish:

1. Finish: Match existing finish and stain on existing corridor doors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see **Section 087100 "Door Hardware."**

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

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. 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 with fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide **1/8 inch (3 mm)** at heads, jambs, and between pairs of doors. Provide **1/4 inch (6 mm)** from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide **1/4 inch (6 mm)** from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
2. Bevel non-fire-rated doors **1/8 inch in 2 inches (3-1/2 degrees)** at lock and hinge edges.
3. Bevel fire-rated doors **1/8 inch in 2 inches (3-1/2 degrees)** on lock edge; trim stiles and rails only to extent permitted by labeling agency.

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

END OF SECTION 081433

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hollow-metal work.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required.
- F. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amweld International, LLC.
 - 2. Ceco Door Products; an Assa Abloy Group company.
 - 3. Daybar.

4. Fleming-Baron Door Products.
5. Hollow Metal Inc.
6. Karpen Steel Custom Doors & Frames.
7. Steelcraft; an Ingersoll-Rand company.
8. Stiles Custom Metal, Inc.
9. Titan Metal Products, Inc.
10. West Central Mfg. Inc.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. Standard-Duty Doors and Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule.
1. Physical Performance: Level C according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.032 inch (0.8 mm).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard.
 3. Frames:
 - a. Materials: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - b. Construction: Full profile welded.
 4. Exposed Finish: Factory.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.
1. Physical Performance: Level B according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.

- b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard.
- 3. Frames:
 - a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Construction: Full profile welded.
- 4. Exposed Finish: Factory.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), 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 (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.5 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- G. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- H. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).
- J. Glazing: Section 088000 "Glazing."
- K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat.

2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 1. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

- b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - c. Compression Type: Not less than two anchors in each frame.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
- 5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
 - 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.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- E. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: SDI A250.10.
- B. Factory Finish: SDI A250.3.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: 3/4 inch (19.1 mm) plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.2 ADJUSTING AND CLEANING

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

END OF SECTION 081113

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.
 - 2. Floor access doors and frames.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material.
- D. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 tested according to the following test method:
 - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
 - 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 - 1. Access Panel Solutions.
 - 2. Babcock-Davis.
 - 3. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - 4. Karp Associates, Inc.
 - 5. Nystrom, Inc.
 - 6. Williams Bros. Corporation of America (The).

- C. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- D. Flush Access Doors with Exposed Flanges:
 - 1. Basis-of-Design Product: Indicated on Drawings.
 - 2. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 - 3. Locations: Wall.
 - 4. Door Size: <Insert door size>.
 - 5. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
 - a. Finish: Factory finish.
 - 6. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage.
 - a. Finish: Factory finish.
 - 7. Frame Material: Same material, thickness, and finish as door.
 - 8. Hinges: Manufacturer's standard.
 - 9. Hardware: Lock.
- E. Hardware:
 - 1. Lock: Cylinder.
 - a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100 "Door Hardware."

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- E. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- F. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- G. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness according to ANSI H35.2 (ANSI H35.2M).
- H. Frame Anchors: Same type as door face.

- I. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
 1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 1. For cylinder locks, furnish two keys per lock and key all locks alike.
 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.
- F. Extruded Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:
 - a. Swinging doors.
2. Cylinders for door hardware specified in other Sections.

B. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.

1. Lock cylinders to be installed under other Sections.
2. Permanent lock cores to be installed by Owner.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Details of electrified door hardware.

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

D. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - b. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Door Hardware.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
 - 1. For door hardware, an Architectural Hardware Consultant (AHC).
- C. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of **0.3 cfm/sq. ft. (3 cu. m per minute/sq. m)** at the tested pressure differential of **0.3-inch wg (75 Pa)** of water.
- F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- G. Means of Egress Doors: Latches do not require more than **15 lbf (67 N)** to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- H. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- B. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled on Drawings to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Baldwin Hardware Corporation.
 - b. Bommer Industries, Inc.
 - c. Cal-Royal Products, Inc.
 - d. Hager Companies.
 - e. McKinney Products Company; an ASSA ABLOY Group company.

2.3 MECHANICAL LOCKS AND LATCHES

- A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- B. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Arrow USA; an ASSA ABLOY Group company.
 - b. Cal-Royal Products, Inc.
 - c. Falcon Lock; An Ingersoll-Rand Company.
 - d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - e. Schlage Commercial Lock Division; an Ingersoll-Rand company.
- C. Mortise Locks: BHMA A156.13; Security Grade 1; stamped steel case with steel or brass parts; Series 1000.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Arrow USA; an ASSA ABLOY Group company.
 - b. Cal-Royal Products, Inc.
 - c. Falcon Lock; an Ingersoll-Rand company.
 - d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - e. Schlage Commercial Lock Division; an Ingersoll-Rand company.

2.4 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.

- b. Burns Manufacturing Incorporated.
- c. Door Controls International, Inc.
- d. IVES Hardware; an Ingersoll-Rand company.
- e. Trimco.

2.5 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

- A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Cal-Royal Products, Inc.
 - b. Door Controls International, Inc.
 - c. IVES Hardware; an Ingersoll-Rand company.
 - d. Trimco.

2.6 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
 - 1. Manufacturer: Same manufacturer as for locking devices.
 - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Arrow USA; an ASSA ABLOY Group company.
 - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - c. Falcon Lock; an Ingersoll-Rand company.
 - d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - e. Schlage Commercial Lock Division; an Ingersoll-Rand company.
- B. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.7 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
 - 1. No Master Key System: Only change keys operate cylinder.
 - 2. Master Key System: Change keys and a master key operate cylinders.

3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.
5. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
6. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: Information to be furnished by Owner.
2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.
 - b. Master Keys: Five.
 - c. Grand Master Keys: Five.
 - d. Great-Grand Master Keys: Five.

2.8 OPERATING TRIM

A. Operating Trim: BHMA A156.6; aluminum, unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Burns Manufacturing Incorporated.
 - b. Hager Companies.
 - c. IVES Hardware; an Ingersoll-Rand company.
 - d. Rockwood Manufacturing Company.
 - e. Trimco.

2.9 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Architectural Builders Hardware Mfg., Inc.
 - b. Glynn-Johnson; an Ingersoll-Rand company.

- c. Rockwood Manufacturing Company.
- d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

2.10 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
 - 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.11 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

- 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: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- C. 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."
- D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number 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.
- F. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every **30 inches (750 mm)** of door height greater than **90 inches (2286 mm)**.
- G. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- H. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- I. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- J. 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 will impede traffic.
- K. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- L. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- M. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- N. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as

intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.2 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

END OF SECTION 087100

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board wall assemblies.
2. Suspension systems for interior gypsum ceilings and soffits.
3. Non-load-bearing steel framing systems for interior gypsum board ceiling assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.
- B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413.

2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Steel Studs and Runners: ASTM C 645. Use either steel studs, 'CH' studs, 'J'-runners, track runners and required associated products per rated-assembly requirements or building system requirements, of equivalent minimum base-metal thickness.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Clark Western Building Systems.
 - b. Dale Industries.
 - c. Telling Industries.
 2. Minimum Base-Metal Thickness: 0.0329 inch

3. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide[**one of**] the following in thickness not less than indicated for studs and in width to accommodate depth of studs:
1. Single Long-Leg Runner System: ASTM C 645 top runner with **2-inch- (51-mm-)** deep flanges, installed with studs friction fit into top runner and with continuous bridging located within **12 inches (305 mm)** of the top of studs to provide lateral bracing.
 2. Double-Runner System: ASTM C 645 top runners, inside runner with **2-inch- (51-mm-)** deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) MBA Building Supplies; **FlatSteel Deflection Track**.
 - 3) Steel Network Inc. (The); **VertiClip SLD or VertiTrack VTD Series**.
 - 4) Superior Metal Trim; Superior Flex Track System (SFT).
 - 5) Telling Industries; **Vertical Slip Track or Vertical Slip Track II**.
- D. Firestop Tracks: Manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Trak Corp.; Fire Trak System **attached to studs with Fire Trak Posi Klip**.
 - b. Grace Construction Products; FlameSafe FlowTrak System.
 - c. Metal-Lite, Inc.; The System.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: As indicated on Drawings.
- F. Cold-Rolled Channel Bridging: Steel, **0.053-inch (1.34-mm)** minimum base-metal thickness, with minimum **1/2-inch- (13-mm-)** wide flanges.
1. Depth: As indicated on Drawings.
 2. Clip Angle: Not less than **1-1/2 by 1-1/2 inches (38 by 38 mm)**, **0.068-inch- (1.72-mm-)** thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: As indicated on Drawings.
 2. Depth: As indicated on Drawings.
- H. Resilient Furring Channels: **1/2-inch- (13-mm-)** deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Hat shaped.

- I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.3 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide asphalt saturated organic felt or foam gasket.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch (13-mm)** clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs **6 inches (150 mm)** o.c.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (610 mm)** o.c.
- F. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced **24 inches (610 mm)** o.c.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (610 mm)** o.c.
 - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than **12 inches (305 mm)** from corner and cut insulation to fit.

- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch (3 mm)** from the plane formed by faces of adjacent framing.
- H. finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- C. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site.

2.3 INTERIOR GYPSUM BOARD

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

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. PABCO Gypsum.
7. Temple-Inland.
8. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: **1/2 inch (12.7 mm)**.
2. Long Edges: Tapered.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: **5/8 inch (15.9 mm)**.
2. Long Edges: Tapered.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide **1/4- to 1/2-inch- (6.4- to 12.7-mm-)** wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 1. Aluminum Trim: Install in locations indicated on Drawings.
 2. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- E. Prefill open joints and damaged surface areas.

- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 3: Where indicated on Drawings.
 - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 - 5. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- H. Texture Finish Application: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.
- I. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- J. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]**.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.

2.2 ACOUSTICAL PANELS

- A. Manufacturers: Use Mars Clima Plus Ceilings Item No. 86985.
- B. Color: White.
- C. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.

- D. Thickness: 3/4 inch (19 mm).
- E. Modular Size: 24 by 24 inches (610 by 610 mm).

2.3 METAL SUSPENSION SYSTEM

- A. Manufacturers: Use Donn Centricitee DXT/DXLT 9/16".
- B. Narrow-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 (Z90) coating designation; with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Steel cold-rolled sheet.
 - 5. Cap Finish: Painted white.
- C. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
 - 1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.2 QUALITY ASSURANCE

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

1.3 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allstate Rubber Corp.; Stoler Industries.
 - b. Armstrong World Industries, Inc.
 - c. Flexco, Inc.
 - d. Johnsonite.
 - e. Mondo Rubber International, Inc.
 - f. Musson, R. C. Rubber Co.
 - g. Roppe Corporation, USA.
 - h. VPI, LLC; Floor Products Division.

- B. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TV (vinyl, thermoplastic).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (102 mm).
- E. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.
- F. Finish: As selected by Architect from manufacturer's full range.
- G. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.

4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum **75 percent** relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 RESILIENT BASE INSTALLATION

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

3.3 CLEANING AND PROTECTION

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

END OF SECTION 096513

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Gypsum board
 - 2. Plaster
 - 3. Ply wood

1.2 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.
- C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than **1 gal. (3.8 L)** of each material and color applied.

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, **available products that may be incorporated into the Work include, but are not limited to products** listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. 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.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Floor Coatings: 100 g/L.
 - 9. Shellacs, Clear: 730 g/L.
 - 10. Shellacs, Pigmented: 550 g/L.

- D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Colors: As selected by Owner from manufacturer's full range.

2.3 PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior:[**MPI #50.**]
- B. Primer, Alkali Resistant, Water Based:[**MPI #3.**]
- C. Primer Sealer, Interior, Institutional Low Odor/VOC:[**MPI #149.**]
- D. Primer, Latex, for Interior Wood:[**MPI #39.**]
- E. Primer Sealer, Alkyd, Interior:[**MPI #45.**]
- F. Primer, Bonding, Water Based:[**MPI #17.**]
- G. Primer, Bonding, Solvent Based:[**MPI #69.**]
- H. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.4 METAL PRIMERS

- A. Primer, Rust-Inhibitive, Water Based:[**MPI #107.**]
- B. Primer, Alkyd, Anti-Corrosive, for Metal:[**MPI #79.**]
- C. Primer, Alkyd, Quick Dry, for Metal:[**MPI #76.**]
- D. Primer, Galvanized, Water Based:[**MPI #134.**]
- E. Primer, Vinyl Wash:[**MPI #80.**]
- F. Primer, Quick Dry, for Aluminum:[**MPI #95.**]

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.

2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.
5. Plaster: 12 percent.

- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. 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.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 099123

SECTION 102213 - WIRE MESH PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard-duty wire mesh partitions.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. American Woven Wire Corporation.
2. G-S Company (The).
3. King Wire Partitions, Inc.
4. R. J. Donaldson, Inc.
5. Standard Wire & Steel Works.
6. Woven Wire Product Association.

2.2 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **25**percent.
- B. Steel Wire: **ASTM A 510** (ASTM A 510M).
- C. Steel Plates, Channels, Angles, and Bars: ASTM A 36/A 36M.
- D. Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- E. Steel Tubing: ASTM A 500/A 500M, cold-formed structural-steel tubing or ASTM A 513, Type 5, mandrel-drawn mechanical tubing.

- F. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating designation.
- G. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.

2.3 STANDARD-DUTY WIRE MESH PARTITIONS

- A. Mesh: **0.135-inch- (3.5-mm-)** diameter, intermediate-crimp steel wire woven into **1-1/2-inch (38-mm)** diamond mesh.
- B. Vertical Panel Framing: **1-1/4-by-5/8-by-0.080-inch (32-by-16-by-2.0-mm)** cold-rolled, C-shaped steel channels with holes for **1/4-inch- (6-mm-)** diameter bolts not more than **12 inches (300 mm)** o.c.
- C. Horizontal Panel Framing: **1-by-1/2-by-1/8-inch (25-by-13-by-3.2-mm)** cold-rolled steel channels.
- D. Horizontal Panel Stiffeners: Two cold-rolled steel channels, **3/4 by 3/8 by 1/8 inch (19 by 9.5 by 3.2 mm)**, bolted or riveted toe to toe through mesh or one **1-by-1/2-by-1/8-inch (25-by-13-by-3.2-mm)** cold-rolled steel channel with wire mesh woven through channel.
- E. Top Capping Bars: **2-1/4-by-1-inch (57-by-25-mm)** cold-rolled steel channels.
- F. Posts for 90-Degree Corners: **1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3.2-mm)** steel angles or square tubes with holes for **1/4-inch- (6-mm-)** diameter bolts aligning with bolt holes in vertical framing; with floor anchor clips.
- G. Line Posts: **3-inch-by-4.1-lb (76-mm-by-1.9-kg)** or **3-1/2-by-1-1/4-by-0.127-inch (89-by-32-by-3.2-mm)** steel channels; with **1/4-inch (6.4-mm)** steel base plates.
- H. Three-Way Intersection Posts: **1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3.2-mm)** steel tubes or channels, with holes for **1/4-inch- (6-mm-)** diameter bolts aligned for bolting to adjacent panels.
- I. Floor Shoes: Metal, not less than **2 inches (50 mm)** high; sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.
- J. Sliding Doors: Fabricated from same mesh as partitions, with framing fabricated from **1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3.2-mm)** steel channels, banded with **1-1/2-by-1/8-inch (38-by-3.2-mm)** flat steel bar cover plates on four sides.
 - 1. Hardware: Two, four-wheel roller-bearing carriers, box track, and bottom guide channel for each door.
 - 2. Padlock Lug: Mortised into door framing and enclosed with steel cover.
 - 3. Cylinder Lock: Mortise type with **manufacturer's standard cylinder**; operated by key outside and **lever** inside.
- K. Finish: **Shop primed for field painting** unless otherwise indicated.
 - 1. Color: **As selected by Architect from manufacturer's full range**

PART 3 - EXECUTION

3.1 WIRE MESH PARTITIONS ERECTION

- A. Anchor wire mesh partitions to floor with 3/8-inch- (9.5-mm-) diameter postinstalled expansion anchors at 12 inches (300 mm) o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.
- B. Anchor wire mesh partitions to floor with 3/8-inch- (9.5-mm-) diameter postinstalled expansion anchors at 12 inches (305 mm) o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.
- C. Anchor wire mesh partitions to walls at 12 inches (305 mm) o.c. through back corner panel framing.
- D. Secure top capping bars to top framing channels with 1/4-inch- (6-mm-) diameter "U" bolts spaced not more than 28 inches (700 mm) o.c.
- E. Provide line posts at locations indicated.
- F. Provide seismic supports as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.
- G. Where standard-width wire mesh partition panels do not fill entire length of run, provide filler panels to fill openings.
- H. Install doors complete with door hardware.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 102213

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. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Fire-suppression equipment and piping demolition.
 - 7. 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 and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Mechanical sleeve seals.

1.5 QUALITY ASSURANCE

- A. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 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.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

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 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.

2.4 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.

2.5 ESCUTCHEONS

- A. Description: Plastic wall and ceiling escutcheons, with an ID to closely fit around pipe and an OD that completely covers opening.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

- A. 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.

- B. 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. (Applicable to other systems piping and equipment if damage is a direct result of the work included in this specification).

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. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. 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.
- Q. Verify final equipment locations for roughing-in.
- R. 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 CONCRETE BASES

- A. Refer to Division 03 Section "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete."
- B. Anchor equipment to concrete base according to equipment manufacturer's written instructions.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

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

3.6 GROUTING

- A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

END OF SECTION 210500

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. Metraflex Company (The).
 4. Pipeline Seal and Insulator, Inc.
 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Stainless steel.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Interior Partitions:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.

- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 210518

SECTION 210513 – COMMON MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION 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. This Section specifies the motors for fire-suppression equipment 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. Applicable sections of Division 26 - Electrical

1.3 SUBMITTALS

- A. Shop Drawings
 - 1. Motors

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 Motors

- A. Motors 1/2 HP and larger shall be 208, 230, or 460 volts, 3 phase. Motors shall be size and rating as indicated on the drawing. Motors that are an integral part of special equipment may vary from above to meet manufacturing standards.

PART 3 - EXECUTION

Not Used

END OF SECTION 210513

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 and equipment 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 211100 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following fire-suppression piping inside the building:
 - 1. Automatic wet-type, Class I standpipe systems.
 - 2. Combined wet-pipe sprinkler system.
- B. See Division 10 Sections "Fire Extinguisher Cabinets" and "Fire Extinguishers" for cabinets and fire extinguishers.
- C. See Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.

1.2 SYSTEM DESCRIPTIONS

- A. Combined Standpipe and Sprinkler System: Fire-suppression system with both standpipe and sprinkler systems. Sprinkler system is supplied from standpipe system.
- B. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- C. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included.

1.3 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-suppression standpipe system design shall be approved by WSU - Authorities Having Jurisdiction.
 - 1. Minimum Residual Pressure at Each Hose-Connection Outlet: 65 psig.
 - 2. Unless otherwise indicated, the following is maximum residual pressure at required flow at each hose connection outlet: 100 psi.
- C. Fire-suppression sprinkler system design shall be approved by WSU - Authorities Having Jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:

- a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Office and Public Areas: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm/sq.ft. over 1500 sq. ft..
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq.ft. over 1500 sq. ft..
4. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 120 sq. ft..
 - b. Storage Areas: 130 sq. ft..
 - c. Mechanical Equipment Rooms: 130 sq. ft..
 - d. Electrical Equipment Rooms: 130 sq. ft..
 - e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.4 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
- C. Field test reports and certificates.
- D. Field quality-control test reports.
- E. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 1. NFPA 13, "Installation of Sprinkler Systems."
 2. NFPA 14, "Installation of Standpipe and Hose System".

3. NFPA 24, "Installation of Private Fire Service Main".
4. NFPA 230, "Fire Suppression of Storage".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
 1. Malleable-Iron Threaded Fittings: ASME B16.3.
 2. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 3. Steel Threaded Couplings: ASTM A 865.
- B. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut-grooved ends.
 1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Central Sprinkler Corp.
 - 3) Ductilic, Inc.
 - 4) JDH Pacific, Inc.
 - 5) National Fittings, Inc.
 - 6) Shurjoint Piping Products, Inc.
 - 7) Southwestern Pipe, Inc.
 - 8) Star Pipe Products; Star Fittings Div.
 - 9) Victaulic Co. of America.
 - 10) Ward Manufacturing.
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

2.3 FLEXIBLE CONNECTORS

- A. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
 - 1. NPS 2 and Smaller: Threaded.
 - 2. NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.
- B. Manufacturers:
 - 1. Anamet Inc.
 - 2. Flex-Hose Co., Inc.
 - 3. Flexicraft Industries.
 - 4. Flex-Pression, Ltd.
 - 5. Flex-Weld, Inc.
 - 6. Hyspan Precision Products, Inc.
 - 7. Mercer Rubber Co.
 - 8. Metraflex, Inc.
 - 9. Proco Products, Inc.
 - 10. Unaflex Inc.
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.4 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Outlet Specialty Fittings:
 - 1. Manufacturers:
 - a. Anvil International, Inc.
 - b. Central Sprinkler Corp.
 - c. JDH Pacific, Inc.
 - d. National Fittings, Inc.
 - e. Southwestern Pipe, Inc.
 - f. Star Pipe Products; Star Fittings Div.
 - g. Victaulic Co. of America.
 - 2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.
 - 3. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded outlet.

- C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
 - 1. Manufacturers:
 - a. Central Sprinkler Corp.
 - b. Fire-End and Croker Corp.
 - c. Viking Corp.
 - d. Victaulic Co. of America.
- D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
 - 1. Manufacturers:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Fire-End and Croker Corp.
 - c. Potter-Roemer; Fire-Protection Div.
- E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
 - 1. Manufacturers:
 - a. AGF Manufacturing Co.
 - b. Central Sprinkler Corp.
 - c. G/J Innovations, Inc.
 - d. Triple R Specialty of Ajax, Inc.
- F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
 - 1. Manufacturers:
 - a. CECA, LLC.
 - b. Merit.

2.5 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
 - 1. Manufacturers:
 - a. Grinnell Fire Protection.
 - b. Kennedy.
 - c. NIBCO.
 - d. Stockham.
- C. Gate Valves: UL 262, OS&Y type.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.

- a. Manufacturers:
 - 1) Crane Co.; Crane Valve Group; Crane Valves.
 - 2) Hammond Valve.
 - 3) NIBCO.
 - 4) United Brass Works, Inc.
- 2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
 - a. Manufacturers:
 - 1) Grinnell Fire Protection
 - 2) Kennedy
 - 3) NIBCO.
 - 4) Stockham
- D. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
 - 1. Indicator: Electrical, 115-V ac, prewired, 2-circuit, supervisory switch.
 - 2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
 - a. Manufacturers:
 - 1) Grinnell Fire Protection
 - 2) Kennedy
 - 3) NIBCO.
 - 4) Stockham
 - 3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
 - a. Manufacturers:
 - 1) Grinnell Fire Protection.
 - 2) Kennedy
 - 3) NIBCO.
 - 4) Stockham

2.6 UNLISTED GENERAL-DUTY VALVES

- A. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" or Division 23 Section "General-Duty Valves for HVAC Piping" if lists of manufacturers are required.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.7 SPECIALTY VALVES

- A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
 - 1. Manufacturers:
 - a. Grinnell Fire Protection.
 - b. Kennedy
 - c. NIBCO
 - d. Stockham
 - 2. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
 - a. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
 - b. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
- B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.
 - 3. Manufacturers:
 - a. Grinnell Fire Protection.
 - b. Kennedy
 - c. NIBCO
 - d. Stockham

2.8 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Manufacturers:
 - 1. Central Sprinkler Corp.
 - 2. Grinnell Fire Protection.
 - 3. Reliable Automatic Sprinkler Co., Inc.
 - 4. Viking Corp.
- C. Automatic Sprinklers: With heat-responsive element complying with the following:
 - 1. UL 199, for nonresidential applications.
 - 2. UL 1626, for residential applications.
 - 3. UL 1767, for early-suppression, fast-response applications.
- D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- E. Sprinkler types, features, and options as follows:
 - 1. Concealed ceiling sprinklers, including cover plate.

2. Pendent sprinklers.
 3. Upright sprinklers.
- F. Sprinkler Finishes: Chrome plated, bronze, and painted.
- G. Special Coatings: Wax, lead, and corrosion-resistant paint.
- H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Plastic, white finish, one piece, flat to match existing.
- I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.9 FIRE DEPARTMENT HOSE CONNECTIONS

- A. Manufacturers:
1. Elkhart Brass Mfg. Co., Inc.
 2. Grinnell Fire Protection.
 3. Guardian Fire Equipment Incorporated.
 4. Mueller Company.
 5. Potter-Roemer; Fire-Protection Div.
 6. United Brass Works, Inc.
- B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include angle or gate pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 2-1/2 as indicated, and hose valve threads according to NFPA 1963 and matching local (City of Detroit) fire department threads.
1. Valve Operation: Pressure-regulating type.
 2. Finish: Rough metal or chrome-plated

2.10 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 inlet and NPS 1 drain connections.
1. Manufacturers:
 - a. Globe Fire Sprinkler Corporation.
 - b. Grinnell Fire Protection.
 - c. Viking Corp.
- C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V

ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

1. Manufacturers:

- a. ADT Security Services, Inc.
- b. Grinnell Fire Protection.
- c. ITT McDonnell & Miller
- d. Potter Electric Signal Company.
- e. System Sensor.
- f. Viking Corp.
- g. Watts Industries, Inc.; Water Products Div.

D. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

1. Manufacturers:

- a. McWane, Inc.; Kennedy Valve Div.
- b. Potter Electric Signal Company.
- c. System Sensor.

2.11 PRESSURE GAGES

A. Manufacturers:

1. AGF Manufacturing Co.
2. AMETEK, Inc.; U.S. Gauge
3. Brecco Corporation.
4. Dresser Equipment Group; Instrument Div.
5. Marsh Bellofram.
6. WIKA Instrument Corporation.

B. Description: UL 393, 3-1/2- to 4-1/2-inch diameter, dial pressure gage with range of 0 to 250 psig.

1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS, GENERAL

- A. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end pipe couplings; and grooved joints.
- C. Underground Service-Entrance Piping: Ductile-iron, grooved-end pipe and fittings; grooved-end-pipe couplings; and grooved joints.

3.2 STANDPIPE SYSTEM PIPING APPLICATIONS

- A. Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
- D. Grooved-end, black, standard-weight steel pipe with square-cut or rolled-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.3 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. If more than one type of material and joining method is used for a particular pipe size, identify materials on Drawings and show points of transition from one material to another.
- B. NPS 1-1/2 and Smaller: Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
- C. NPS 2 and Larger: Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
- D. NPS 2 and Larger: Grooved-end, , standard-weight steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.4 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13, and NFPA 14.
 - a. Shutoff Duty: Use butterfly or gate valves.
 - 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13, and NFPA 14.
 - a. Shutoff Duty: Use butterfly or gate valves.
 - b. Throttling Duty: Use globe valves.

3.5 JOINT CONSTRUCTION

- A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.

2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

3.6 SERVICE ENTRANCE PIPING

- A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 22 Section "Facility Water Distribution Piping" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water distribution piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.

3.7 WATER SUPPLY CONNECTION

- A. Connect fire-suppression piping to building's interior water distribution piping. Refer to Division 22 Section "Domestic Water Piping" for interior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water distribution piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.

3.8 PIPING INSTALLATION

- A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping installation.
- 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 Engineer before deviating from approved working plans.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler zone control valves, test assemblies, and drain riser adjacent to stand pipe when sprinkler piping is connector to stand pipe.
- I. Install drain valve on stand pipes.

- J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain.
- K. Install alarm devices in piping systems.
- L. Hangers and Supports: Comply with NFPA 13 for hanger materials.
 - 1. Install standpipe system piping according to NFPA 14.
 - 2. Install sprinkler system piping according to NFPA 13.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- N. Fill wet-standpipe system piping with water.
- O. Fill wet-pipe sprinkler system piping with water.
- P. Install flexible connectors on fire-pump and pressure-maintenance pump supply and discharge connections.

3.9 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and NFPA 14 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.
- D. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

3.10 SPRINKLER APPLICATIONS

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
 - 1. Rooms without Ceilings: Upright sprinklers, chrome plated.
 - 2. Rooms with Suspended Ceilings: Pendent, semi-recessed, flush, and concealed sprinklers, as indicated.
 - 3. Wall Mounting: Sidewall sprinklers.
 - 4. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.
 - b. Semi-recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

3.11 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.

3.12 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes, unless otherwise indicated.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install hose-connection valves with flow-restricting device, unless otherwise indicated.

3.13 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- E. Electrical Connections: Power wiring is specified in Division 26.
- F. Connect alarm devices to fire alarm.
- G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.14 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14.

3.15 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system 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.

3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 4. Coordinate with fire alarm tests. Operate as required.
 5. Verify that equipment hose threads are same as local fire department equipment.
- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

END OF SECTION 211000

SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-protection valves.
 - 2. Hose connections.
 - 3. Fire-department connections.
 - 4. Alarm devices.
 - 5. Pressure gages.
- B. Related Sections:
 - 1. Division 21 Section "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
 - 2. Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
 - 3. Division 22 Section "Hangers and Supports for Plumbing and Fire Protection Piping and Equipment."

1.3 DEFINITIONS

- A. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig (1200 kPa) maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- B. Combined Sprinkler / Standpipe System: A standpipe system having piping that supplies both hose connections and automatic sprinklers.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

- B. Delegated Design: Design fire-suppression standpipes for Class I service per NFPA 14 using performance requirements and design criteria indicated.
- C. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
 - 1. Minimum residual pressure at most remote 2-1/2" hose-connection outlet is as follows:
 - a. 65 psig (450 kPa).
 - 2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
 - a. NPS 2-1/2 (DN 65) Hose Connections: 175 psig (1200 kPa).

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Fire-hydrant flow test report.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Suppression Standpipe Service: Do not interrupt fire-suppression standpipe service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression standpipe service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of fire-suppression standpipe service.
 - 2. Do not proceed with interruption of fire-suppression standpipe service without Owner's written permission.

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, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Standard-Weight, Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.
- C. Galvanized, Steel Couplings: ASTM A 865, threaded.
- D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME B16.1, 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. Pressure Rating: 175 psig (1200 kPa) minimum.
 - 3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
- B. Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. NIBCO.
 - c. Victaulic Company.
 - 2. Standard: UL 1091 except with ball instead of disc.
 - 3. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
 - 4. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
 - 5. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.
- C. Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.

- e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. Fire-End & Croker Corporation.
 - g. Kennedy Valve; a division of McWane, Inc.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Potter Roemer.
 - l. Reliable Automatic Sprinkler Co., Inc.
 - m. Shurjoint Piping Products.
 - n. Tyco Fire & Building Products LP.
 - o. Victaulic Company.
 - p. Viking Corporation.
- 2. Standard: UL 312.
 - 3. Pressure Rating: 250 psig (1725 kPa) minimum.
 - 4. Type: Swing check.
 - 5. Body Material: Cast iron.
 - 6. End Connections: Flanged or grooved.

D. OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Clow Valve Company; a division of McWane, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. Mueller Co.; Water Products Division.
 - h. NIBCO INC.
 - i. Shurjoint Piping Products.
 - j. Tyco Fire & Building Products LP.
- 2. Standard: UL 262.
- 3. Valves NPS 2 (DN 50) and Smaller: Bronze body with threaded ends, 175 psig (1200 kPa) minimum.
- 4. Valves NPS 2-1/2 (DN 65) and Larger: Cast or ductile-iron body with flanged or grooved ends, 250 psig (1725 kPa) minimum.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Pressure Rating: 175 psig (1200 kPa) minimum.

B. Ball Valves:

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

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Fire-End & Croker Corporation.
- c. Kennedy Valve; a division of McWane, Inc.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Potter Roemer.
- g. Tyco Fire & Building Products LP.
- h. Victaulic Company.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

C. Pressure-Reducing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-End & Croker Corporation.
 - b. Guardian Fire Equipment, Inc.
 - c. Potter Roemer.
 - d. Tyco Fire & Building Products LP.
2. UL 668 hose valve, with integral UL 1468 reducing device.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Material: Brass or bronze.
5. Inlet: Female pipe threads.
6. Outlet: Threaded with or without adapter having male hose threads.

7. Pattern: Angle or gate.
8. Finish: Polished chrome plated.

D. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 (DN 20).
6. End Connections: Threaded.

2.7 HOSE CONNECTIONS

A. Nonadjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Guardian Fire Equipment, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Mueller Co.; Water Products Division.
 - f. NIBCO INC.
 - g. Potter Roemer.
 - h. Tyco Fire & Building Products LP.
2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Material: Bronze.
5. Size: NPS 2-1/2 (DN 65), as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle.
9. Finish: Bronze.

2.8 FIRE-DEPARTMENT CONNECTIONS

- A. Refer to Specification Section 221113 – Facility Water Distribution Piping – Fire Service Mains.

2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tyco Fire & Building Products LP.
 - b. Victaulic Company.
 - c. Viking Corporation.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch (250-mm) diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4 (DN 20).
8. Outlet: NPS 1 (DN 25) drain connection.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McDonnell & Miller; ITT Industries.
 - b. Potter Electric Signal Company.
 - c. System Sensor; a Honeywell company.
 - d. Viking Corporation.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig (1725 kPa).
7. Design Installation: Horizontal or vertical.

D. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 - c. Tyco Fire & Building Products LP.
 - d. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.10 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AMETEK; U.S. Gauge Division.
 2. Ashcroft Inc.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

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

3.3 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression standpipe piping to water-service piping at service entrance into building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping".
- B. Install shutoff valve, backflow preventer, pressure gage, drain and other accessories at connection to fire-suppression water-service piping. Comply with requirements for backflow preventers in Division 22 Section "Domestic Water Piping Specialties".

3.4 WATER-SUPPLY CONNECTIONS

- A. Connect fire-suppression standpipe piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping".
- B. Install shutoff valve, backflow preventer, pressure gage, drain and other accessories at connection to water-distribution piping. Comply with requirements for backflow preventers in Division 22 Section "Domestic Water Piping Specialties".

3.5 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 in NFPA 14 for installation of fire-suppression standpipe piping.
- D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install drain valve at the bottom of each riser. The minimum (see drawings for size) riser drain lines shall terminate on grade (see drawings for proposed location). Coordinate in the field for wall penetrations.
- F. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain.
- G. Install alarm devices in piping systems. A flow alarm switch shall be provided in the feed main and shall be wired into the fire alarm system. A separate flow alarm switch for the standpipe risers is not required for the combined system.
- H. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

- I. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal.
- J. Provide an air cushion approved pressure gauge with 3-way valve connections at the top of each standpipe in an easily visible location such as a stairwell.
- K. Fill wet-type standpipe system piping with water.

3.6 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. 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.
- I. 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.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

3.7 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. System water supply valves, isolation control valves, and other valves in feed mains shall be supervised with tamper switches and also be locked open. Padlocks with Best cylinders will be provided by WSU, and installed by the Contractors.
- D. Install backflow preventers in potable-water-supply sources.
- E. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.

3.8 HOSE-CONNECTION INSTALLATION

- A. Install hose connection adjacent to standpipes.

3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install free-standing type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.
 5. Start and run air compressors.
 6. Coordinate with fire-alarm tests. Operate as required.
 7. Coordinate with fire-pump tests. Operate as required.
 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 DEMONSTRATION

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

3.13 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves (Inside the Building): Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Piping between Domestic Water Supply Connection and Backflow Preventers (Inside the Building): Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- C. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 2 and smaller, shall be the following:
1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- D. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 2-1/2 and larger, shall be one of 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.

END OF SECTION 211200

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

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. Split case fire pumps.
 - 2. Fire-pump accessories and specialties.

1.3 PERFORMANCE REQUIREMENTS

- A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Product Certificates: For each fire pump, from manufacturer.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.
- G. Approval from the "AHJ" (Authority Having Jurisdiction).

1.5 CLOSE OUT SUBMITTALS

- A. Operation and Maintenance Data.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

- A. Description: Factory-assembled and -tested fire-pump and driver unit.
- B. Finish: Red paint applied to factory-assembled and -tested unit before shipping.
- C. UL listed and FM approval.
- D. Pump shall be of capacity and electrical characteristics as scheduled, and capable of delivering not less than 150% of rated flow at not less than 65% rated head, and with shutoff head not more than 120% of rated head.
- E. The fire pump manufacturer shall align the pump and motor. Pump shall be hydrostatically tested and run tested prior to shipment. Test pressure shall not be less than 150% of shutoff head plus suction head, but in no case less than 250 psi.

2.2 HORIZONTALLY MOUNTED, SINGLE-STAGE, SPLIT-CASE FIRE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A-C Fire Pump Systems; a business of ITT Industries.
 - 2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
 - 3. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
 - 4. Peerless Pump, Inc.
 - 5. Pentair Pump Group; Aurora Pump.
 - 6. S.A. Armstrong Limited.
- B. Pump:
 - 1. Standard: UL 448, for split-case pumps for fire service.
 - 2. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.

3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Wear Rings: Replaceable bronze.
5. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
6. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
- C. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
- D. Driver:
 1. Standard: UL 1004A.
 2. Type: Electric motor; NEMA MG 1, polyphase Design B.
- E. Capacities and Characteristics: Refer to drawings.

2.3 FIRE-PUMP ACCESSORIES AND SPECIALTIES

- A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
- B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.
- C. Relief Valves: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.
- D. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
- E. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
- F. Discharge Cone: Closed or open type.
- G. Hose Valve Manifold Assembly: (Exterior Free-Standing Fire Pump Test Header)
 1. Standard: Comply with requirements in NFPA 20.
 2. Header Pipe: ASTM A 53/A 53M, Schedule 40, ductile iron with ends threaded according to ASME B1.20.1.
 3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
 4. Manifold:
 - a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - b. Body: Ductile iron, with number of outlets required by NFPA 20.
 - c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
 - d. Adapters and Caps with Chain: Bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - e. Escutcheon Plate: Bronze; rectangular.
 - f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.

- g. Exposed Parts Finish: Rough brass.
- h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

2.4 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
 - 1. Verification of Performance: Rate fire pumps according to UL 448.
- B. Fire pumps will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."
- C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
- D. Support piping and pumps separately so weight of piping does not rest on pumps.
- E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Division 21 Section "Wet-Pipe Sprinkler Systems."
- F. Install listed OS&Y gate valves in the suction pipe. Install listed indicating gate valves in the pump discharge and in bypass line.
- G. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings.
- H. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.

- I. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- J. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- K. Start Up Services: Performed by a factory-authorized service representative.

3.3 ALIGNMENT

- A. Align end-suction and split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

3.4 CONNECTIONS

- A. Comply with requirements for piping and valves specified in Division 21 Section "Wet-Pipe Sprinkler Systems." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect relief-valve discharge to drainage piping or point of discharge.
- D. Connect flowmeter-system meters, sensors, and valves to tubing.
- E. Connect fire pumps to their controllers.

3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.6 FIELD QUALITY CONTROL

- A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Division 21 Section "Controllers for Fire-Pump Drivers."
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
2. Test according to NFPA 20 for acceptance and performance testing.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

F. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

3.7 DEMONSTRATION

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

END OF SECTION 213113

SECTION 213400 - PRESSURE-MAINTENANCE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vertical multi stage pressure maintenance pumps.

B. Related Section:

1. Division 21 Section "Controllers For Fire-Pump Drivers" for pressure-maintenance-pump controllers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: For pumps, accessories, and specialties. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

- C. Field quality-control reports.

- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.4 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 VERTICAL-MULTI STAGE CENTRIFUGAL, PRESSURE-MAINTENANCE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A-C Fire Pump Systems; a business of ITT Industries.
 - 2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
 - 3. Peerless Pump, Inc.
 - 4. Pentair Pump Group; Aurora Pump.
 - 5. Grundfos.
 - 6. S.A. Armstrong Limited.
- B. Description: Factory-assembled and -tested, vertical, multistage, centrifugal inline pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted above pump head.
- C. Pump Construction:
 - 1. Pump Head: Stainless steel 304, for surface discharge, with flange, except connections may be threaded in sizes in which flanges are not available.
 - 2. Pump Head Seal: Stuffing box and stuffing.
 - 3. Line Shaft: Stainless steel, with corrosion-resistant shaft sleeves.
 - 4. Line Shaft Bearings: Silicone carbide.
 - 5. Rubber Parts: EPDM or FKM.
 - 6. Impeller Shaft: Stainless steel.
 - 7. Chamber and impeller: Stainless steel.
 - 8. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections 10 feet (3 m) or less, with strainer of cast or fabricated bronze or stainless steel at bottom.
- D. Motor: Single speed with permanently lubricated ball bearings. Comply with requirements in Division 21 Section "Common Motor Requirements for Fire Suppression Equipment."
- E. Base: Stainless steel with hole for electrical cable.
- F. Nameplate: Permanently attached to pump and indicating capacity and characteristics.
- G. Capacities and Characteristics:

As specified on drawings, see schedule.

 - 1. Pump-Start, Pressure-Switch Setting: 60 psig.
 - 2. Pump-Stop, Pressure-Switch Setting: 75 psig.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 21 Section "Common Motor Requirements for Fire Suppression Equipment."
 - 1. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.
- B. Base-Mounted Pump Mounting: Install pumps on concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 5. Attach pumps to equipment base using anchor bolts.
- C. Install vertical-multi stage centrifugal, pressure-maintenance pumps according to HI 2.4.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.3 ADJUSTING

- A. Lubricate pumps as recommended by manufacturer.
- B. Set field-adjustable pressure-switch ranges as indicated.

END OF SECTION 213400

SECTION 213900 - CONTROLLERS FOR FIRE-PUMP DRIVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Full-service, full-voltage controllers rated 600 V and less.
2. Controllers for pressure-maintenance pumps.

1.2 DEFINITIONS

- A. ECM: Electronic control module.
- B. MCCB: Molded-case circuit breaker.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.
1. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
 2. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.
- C. Qualification Data: For qualified testing agency.
- D. Manufacturer's factory test reports of fully assembled and tested equipment.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.
- 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. Comply with standards of authorities having jurisdiction pertaining to materials and installation.

- D. Comply with NFPA 20 and NFPA 70.
- E. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

PART 2 - PRODUCTS

2.1 FULL-SERVICE CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aquarius Fluid Products, Inc.
 - 2. ASCO Power Technologies, LP; Firetrol Products.
 - 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 4. Hubbell Incorporated; Hubbell Industrial Controls.
 - 5. Joslyn Clark Corporation.
 - 6. Master Control Systems, Inc.
 - 7. Metron, Inc.
- B. General Requirements for Full-Service Controllers:
 - 1. Comply with NFPA 20 and UL 218.
 - 2. Listed by an NRTL for electric-motor driver for fire-pump service.
 - 3. Combined automatic and nonautomatic operation.
 - 4. Factory assembled, wired, and tested; continuous-duty rated.
 - 5. Service Equipment Label: NRTL labeled for use as service equipment.
- C. Method of Starting:
 - 1. Pressure-switch actuated.
 - a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
 - b. System pressure recorder, electric ac driven, with spring backup.
 - c. Programmable minimum-run-time relay to prevent short cycling.
 - d. Programmable timer for weekly tests.
 - 2. Magnetic Controller: Across-the-line type.
 - 3. Solid-State Controller: Across-the-line type.
 - 4. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.
- D. Method of Stopping: Automatic and nonautomatic shutdown after automatic starting.
- E. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.
- F. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and nonthermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.

G. Door-Mounted Operator Interface and Controls:

1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
2. Method of Control and Indication:
 - a. Microprocessor-based logic controller, with multiline digital readout.
 - b. Membrane keypad.
 - c. LED alarm and status indicating lights.
3. Local Alarm and Status Indications:
 - a. Controller power on.
 - b. Motor running condition.
 - c. Loss-of-line power.
 - d. Line-power phase reversal.
 - e. Line-power single-phase condition.
4. Audible alarm, with silence push button.
5. Nonautomatic START and STOP push buttons or switches.

2.2 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aquarius Fluid Products, Inc.
 2. ASCO Power Technologies, LP; Firetrol Products.
 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 4. Hubbell Incorporated; Hubbell Industrial Controls.
 5. Joslyn Clark Corporation.
 6. Master Control Systems, Inc.
 7. Metron, Inc.
- B. General Requirements for Pressure-Maintenance-Pump Controllers:
1. Type: UL 508 factory assembled, -wired, and tested, across-the-line; for combined automatic and manual operation.
 2. Enclosure: UL 508 and NEMA 250, Type 2 for wall-mounting.
 3. Factory assembled, wired, and tested.
 4. Finish: Manufacturer's standard color paint.
- C. Rate controller for scheduled horsepower and include the following:
1. Fusible disconnect switch.
 2. Pressure switch.
 3. Hand-off-auto selector switch.
 4. Pilot light.
 5. Running period timer.

2.3 ENCLOSURES

- A. Fire-Pump Controllers: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.
 - 1. Indoor, Dry and Clean Locations: Type 1 (IEC IP10).
- B. Enclosure Color: Manufacturer's standard "fire-pump-controller red".
- C. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.
- D. Floor stands, 12 inches (305 mm) high, for floor-mounted controllers.

2.4 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20 and UL 218.
 - 1. Verification of Performance: Rate controllers according to operation of functions and features specified.
- B. Fire-pump controllers will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 CONTROLLER INSTALLATION

- A. Install controllers within sight of their respective drivers.
- B. Connect controllers to their dedicated pressure-sensing lines.
- C. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79 inches (2006 mm) above finished floor, and bottom of enclosure not less than 12 inches (305 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- D. Floor-Mounting Controllers: Install controllers on 4-inch (100-mm) nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches (305 mm) above finished floor. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.

- 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- F. Comply with NEMA ICS 15.

3.2 POWER WIRING INSTALLATION

- A. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Comply with NECA 1.

3.3 CONTROL AND ALARM WIRING INSTALLATION

- A. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Division 28 Section "Digital, Addressable Fire-Alarm System."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect remote manual and automatic activation devices where applicable.

3.4 IDENTIFICATION

- A. Comply with requirements in NFPA 20 for marking fire-pump controllers.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Inspect and Test Each Component:
 - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
 - b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
 - c. Test continuity of each circuit.

2. Verify and Test Each Electric-Driver Controller:

- a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify Owner before starting the motor(s).
- b. Test each motor for proper phase rotation.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Field Acceptance Tests:

1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Owner and authorities having jurisdiction.
2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
3. Engage manufacturer's factory-authorized service representative to be present during the testing.
4. Perform field acceptance tests as outlined in NFPA 20.

D. Controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

F. Perform startup service.

G. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

- A. Adjust controllers to function smoothly and as recommended by manufacturer.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.
- C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- D. Set field-adjustable pressure switches.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controllers, and to use and reprogram microprocessor-based controls within this equipment.

END OF SECTION 213900

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. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Plumbing 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 chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
- B. Welding certificates.

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. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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.

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.

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 chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: 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.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

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 PLUMBING DEMOLITION

- A. 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. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- B. 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. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

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

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. 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.
- D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 220500

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration,

assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves.
2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
3. Interior Partitions:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.

- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

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. Bronze lift check valves.
 - 3. Bronze swing check valves.
- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

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. Grooved: With grooves according to AWWA C606.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.
- F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 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: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.3 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.

2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: NBR, PTFE, or TFE.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

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.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service:
 - a. 2" and smaller: Ball valves

2. Pump-Discharge Check Valves:

- a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.5 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 bronze trim.
 - 3. Bronze Swing Check Valves: Class 125, bronze disc.

END OF SECTION 220523

SECTION 220529 -HANGERS AND SUPPORTS FOR PLUMBING AND FIRE PROTECTION 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. Fastener systems.
 - 4. Pipe positioning systems.
 - 5. Equipment supports.

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 and fire protection 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.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

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.

HANGERS AND SUPPORTS FOR PLUMBING AND FIRE PROTECTION PIPING AND EQUIPMENT Bids – June 18, 2013	220529 - 1
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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 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.

HANGERS AND SUPPORTS FOR PLUMBING AND FIRE PROTECTION PIPING AND EQUIPMENT Bids – June 18, 2013	220529 - 2
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2.5 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.

2.6 EQUIPMENT SUPPORTS

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

2.7 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.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping.
- K. Holes shall not be drilled or punched in beams and supporting members. Do not support piping from roof deck, other piping, ducts or equipment.
- L. Hangers and supports shall also be provided at every change of direction and within 1' of any pipe fittings and valves.
- M. 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.
- N. Hanger components shall not be used for purposes other than for which they were designed.
- O. 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.
- P. 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.
- Q. 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.
- R. 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".
- S. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
- T. Riser Supports
 - 1.
 - 2. On a riser subject to expansion, only one support of the rigid type shall be used.
 - 3. Riser clamps shall have a positive means of engagement between the pipe and the clamp.
 - 4. 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.
- U. 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.

- V. 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.
- W. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- X. 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.
- Y. 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.
- Z. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

3.2 EQUIPMENT SUPPORTS

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

3.3 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).

3.4 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 copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use of "C" clamps and beam clamps of "C" pattern and any modifications thereof is prohibited.
- I. 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 8 (DN 15 to DN 200).
 - 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 8 (DN 15 to DN 200).
 - 4. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 8 (DN 100 to DN 200), 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 8 (DN 25 to DN 200), 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 8 (DN 65 to DN 200), 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 8 (DN 50 to DN 200) 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 8 (DN 50 to DN 200) 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 8 (DN 50 to DN 200) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. 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 8 (DN 24 to DN 200).
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 8 (DN 20 to DN 200) if longer ends are required for riser clamps.
- K. 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.
- L. 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.
- M. 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.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.
- S. END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING AND FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 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 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- E. Fasteners: Stainless-steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.5 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.

2.6 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.

2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment including the following:
 - 1. Motor Driven Equipment
 - 2. Starters and Disconnect Switches
 - 3. Control Devices
- B. Locate equipment labels where accessible and visible.
- C. Location signs shall be provided for safety showers, eyewash stations, and emergency gas shutoff

3.3 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. Fire Protection
 - b. Domestic Cold Water
 - c. Domestic Hot Water Supply
 - d. Domestic Hot Water Return
 - e. Sanitary Waste

f. Vent

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. 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. Prepare separate directories and drawings for the plumbing, heating, and air conditioning systems showing system layout as installed, and giving the number, location, and purpose of each component. The Contractor shall contact the A/E before starting the directory to insure proper tagging and listing.
- E. 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.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.

B. Related Sections:

1. Division 22 Section "Plumbing Equipment Insulation."

1.2 SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Indoor Piping Insulation Schedule," where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - 2. Special-Shaped Insulation: ASTM C 552, Type III.
 - 3. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 4. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 - 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.

- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Armacell LLC; Tubolit.
 - b. Nomaco Insulation; IMCOLOCK and NOMALOCK.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide the following:

- a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

1. Products: Subject to compliance with requirements, provide the following:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.

2. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
2. 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).
3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.4 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.5 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.

2.6 TAPES

- A. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.

5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.7 SECUREMENTS

- A. Aluminum Bands: 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 closed seal.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
- 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.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of 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, according to insulation material manufacturer's written instructions, 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. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (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.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 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. 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.

3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. 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.

3.12 PIPING INSULATION SCHEDULE, GENERAL

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

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold, Hot and Recirculated Hot Water: Insulation shall be one of the following:
 - 1. Flexible Elastomeric: 3/4 inch (19 mm) thick.

2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
3. Polyolefin: 3/4 inch (19 mm) thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
 2. PVC: 20 mils (0.5 mm) thick.
 3. Aluminum, Corrugated: 0.016 inch (0.41 mm) thick.
- D. Piping, Exposed:
 1. None.
 2. PVC: 20 mils (0.5 mm) thick.
 3. Aluminum, Corrugated: 0.016 inch (0.41 mm) thick.

END OF SECTION 220719

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING – FIRE SERVICE MAINS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for fire-service mains.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1.4 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution 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 water-distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.5 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
 - 1. Grooved-End, Ductile-Iron Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International, Inc.
 - 2) Victaulic Company of America.
- C. ALTERNATE: ProPress System
 - 1. Copper Press fittings as manufactured by Viega
 - a. Material:
Press Fitting:
Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press end shall have SC (Smart Connect) feature design (leakage path). Smart Connect (SC Feature) in ProPress ½" to 4" dimensions. Assures leakage of liquids from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operations.

2.2 JOINING MATERIALS

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.

2.3 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - a. Standard: AWWA C219.

2.4 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Co.; Valves & Fittings Div.
 - b. American Cast Iron Pipe Co.; American Flow Control Div.
 - c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. East Jordan Iron Works, Inc.
 - f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - g. McWane, Inc.; Kennedy Valve Div.
 - h. McWane, Inc.; M & H Valve Company Div.
 - i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
 - j. Mueller Co.; Water Products Div.
 - k. NIBCO INC.
 - l. U.S. Pipe and Foundry Company.
2. Nonrising-Stem, Metal-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
3. Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - b. East Jordan Iron Works, Inc.
 - c. Flowserve.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.
 - h. U.S. Pipe and Foundry Company.
2. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "FIRE MAIN," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.6 BACKFLOW PREVENTERS

A. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Wilkins; a Zurn company.
2. Standard: ASSE 1015 and ASSE 1048.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
5. Size: 8" NPS (DN).
6. Design Flow Rate: 1,000 gpm (L/s).

7. Selected Unit Flow Range Limits: 1600 gpm (L/s).
8. Pressure Loss at Design Flow Rate: 4 psig (kPa) for NPS 2-1/2 (DN 65) and larger.
9. Body: Stainless steel.
10. End Connections: Flanged.
11. Configuration: Designed for horizontal, straight through flow.
12. Accessories: OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

2.7 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Fire End & Croker Corporation.
 - c. Guardian Fire Equipment, Inc.
 - d. Kidde Fire Fighting.
 - e. Potter Roemer.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Siamese.
2. Description: Freestanding, (Siamese) with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- (460-mm-) high brass sleeve; and round escutcheon plate.
 - a. Standard: UL 405.
 - b. Connections: Two NPS 2-1/2 (DN 65) inlets and one NPS 4 (DN 100) outlet.
 - c. Inlet Alignment: Inline, horizontal.
 - d. Finish Including Sleeve: Polished bronze.
 - e. Escutcheon Plate Marking: "AUTO SPKR & STANDPIPE."

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.

- D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping.
- E. Underground Fire-Service-Main Piping NPS 8 (DN 200) shall be the following:
 - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
- F. Aboveground Fire-Service-Main Piping NPS 8 (DN 200) shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

- A. See Editing Instruction No. 3 in the Evaluations for cautions about selecting products.
- B. General Application: Use mechanical-joint-end valves for underground installation.

Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

- 1. Underground Valves, 8": AWWA, cast-iron, nonrising-stem, resilient -seated gate valves with valve box.
- 2. Use the following for valves aboveground:
 - a. Gate Valves, NPS 3 (DN 80) and Larger: UL/FMG, cast iron, OS&Y rising stem.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Comply with NFPA 24 for fire-service-main piping materials and installation.
- E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

- F. Bury piping with depth of cover over top at least 48 inches, with top below level of maximum frost penetration.
- G. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- H. Sleeves are specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- I. Mechanical sleeve seals are specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- J. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.6 INSTALLATION, COPPER PIPING (ALTERNATE)

Press Connections:

Copper press fitting joints shall be made in accordance with the manufacturer's installation instructions. The piping shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the piping to assure the piping is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

3.7 JOINT CONSTRUCTION

- A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Make pipe joints according to the following:
 - 1. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
 - 2. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 - 3. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.8 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
 - 3. Set-screw mechanical retainer glands.
 - 4. Bolted flanged joints.
 - 5. Pipe clamps and tie rods.

- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 3. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.9 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

3.10 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 (DN 65) and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.11 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install protective pipe bollards on two sides of each fire department connection. Pipe bollards are specified in Division 05 Section "Metal Fabrications."

3.12 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. See Division 22 Section "Common Work Results for Plumbing" for piping connections to valves and equipment.
- C. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve.
- D. Connect water-distribution piping to interior fire-suppression piping.

3.13 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.14 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Division 22 Section "Common Work Results for Plumbing" for identifying devices.

3.15 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated.

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

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

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

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

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.

- c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.
 - g. Stant.
 - h. Tyler Pipe.
- 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 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.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 EARTH MOVING

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

3.2 PIPING INSTALLATION

- A. 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.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Horizontal Sanitary Drainage Piping: 1 percent downward in direction of flow, unless otherwise stated.
 - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

- K. 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" and the Michigan Plumbing Code-2006.
- L. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- M. Plumbing Specialties:
 - 1. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- C. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.5 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 and Fire Protection Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 4. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one 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: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to existing combined storm and sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in floor cleanouts with cover flush with floor.

- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.7 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."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.9 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.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 2. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 2. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI cast-iron hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty cast-iron hubless-piping couplings; coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE 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 sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains and floor sinks.
 - 3. Miscellaneous sanitary drainage piping specialties.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Cast-Iron Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Outlet Connection: Spigot.
7. Closure: Brass plug with straight threads and gasket.
8. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Medium Duty.

2.2 FLOOR DRAINS AND FLOOR SINKS

A. Floor Drains with Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3 with backwater valve.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Backwater Valve: Integral, ASME A112.14.1, ball-float type.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Round.
12. Dimensions of Top or Strainer: 12"
13. Top Loading Classification: Heavy-Duty.
14. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
15. Trap Material: Cast iron.
16. Trap Pattern: Deep-seal P-trap.

B. Floor Sinks with Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3 with backwater valve.
3. Square open top drain.
4. Body Material: Cast iron.

5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Backwater Valve: Integral, ASME A112.14.1, ball-float type.
9. Dimensions: 16" x 16".
10. Inlet Fitting: Gray-iron, with threaded inlet and threaded or spigot outlet.
11. Trap Material: Cast iron.
12. Trap Pattern: Deep seal p-trap.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout.
2. Size: Same as connected waste piping.
 - a. NPS 2-1/2 and Larger: 5-inch minimum water seal.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. Plumbing fixtures are not to be used in place of cleanouts for the removal of obstruction.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. All floor drains shall be flashed with six pound sheet lead, 24 inches square, fitted to the clamping rings on the drains, and with outside edges of flashing worked into the floor construction to effect a watertight installation.
- F. All floor drains and cleanouts which occur in the ground floors which are waterproofed shall be flashed.
- G. Install deep-seal traps on floor drains and other waste outlets.
- H. Install floor-drain, inline floor drain trap sealer on inlet to floor drains and floor sinks.
 1. Size: Same as floor drain inlet.
 2. ASSE 1072 approved.
- I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. High-performance butterfly valves.
2. Bronze swing check valves.
3. Iron swing check valves.
4. Iron gate valves.

B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Handwheel: For valves other than quarter-turn types.
- E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
1. Gate Valves: With rising stem.

F. Valve-End Connections:

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

2.2 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.3 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.

- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

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.
- E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.3 ADJUSTING

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

3.4 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG (104 kPa) OR LESS)

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Ball Valves: [One] [Two] piece, [full] [regular] [reduced] port, [brass] [or] [bronze] with [brass] [bronze] [stainless-steel] trim.
 - 2. Bronze Swing Check Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.
 - 3. Bronze Gate Valves: [Class 125] [Class 150], [NRS] [RS].
 - 4. Bronze Globe Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.

3.5 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball Valves: [One] [Two] piece, [full] [regular] [reduced] port, [brass] [or] [bronze] with [brass] [bronze] [stainless-steel] trim.
2. Bronze Swing Check Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.
3. Bronze Gate Valves: [Class 125] [Class 150], [NRS] [RS].
4. Bronze Globe Valves: [Class 125] [Class 150], [bronze] [nonmetallic] disc.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Fastener systems.
4. Equipment supports.

PART 2 - PRODUCTS

2.1 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 carbon steel.

2.2 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.

2.3 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.

2.4 EQUIPMENT SUPPORTS

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

2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

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. 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.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. 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.

I. 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.
 - d. 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.
2. 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.

3.2 EQUIPMENT SUPPORTS

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

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 attachments for general service applications.
- F. Use thermal-hanger shield inserts for insulated piping and tubing.
- G. 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).

- H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

END OF SECTION 230529

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. See Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each control device indicated.
- B. Shop Drawings:
 - 1. Power, signal, and control wiring diagrams.
 - 2. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
 - 3. Control System Software: Schematic diagrams, written descriptions, and points list.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and firmware operational documentation.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 1. Siemens (for DDC monitoring only)

2. The Cabinet Unit Heater controls are stand alone – at each unit. The DDC monitoring shall be a sub-contract bid through the mechanical contractor. The DDC monitoring shall be a complete system including all power and control wiring, conduit and components for a complete system. Except where specifically indicated as being provided by the electrical contractor on the electrical drawings, it shall be provided by the control contractor through the mechanical contractor.

2.2 DDC EQUIPMENT

- A. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
 1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
- B. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
 1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

2.3 STATUS SENSORS

- A. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- B. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 2. Install exposed cable in raceway.
 3. Install concealed cable in raceway.

4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.
 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 6. Test each system for compliance with sequence of operation.
 7. Test software and hardware interlocks.
- C. DDC Verification:
 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 2. Check instruments for proper operation, location and accessibility.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

END OF SECTION 230900

SECTION 232213 - STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pipe and fittings for LP steam less than 15 psig (104 kPa) and condensate piping.
- B. Related Requirements:
 - 1. Section 232216 "Steam and Condensate Piping Specialties" for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

1.2 ACTION SUBMITTALS

- A. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
 - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
 - 4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.1, "Power Piping," materials, products, and installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
 - 1. LP Steam Piping: 15 psig.
 - 2. Condensate Piping: 15 psig.
 - 3. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, welded and seamless, Grade B, and Schedule as indicated in piping applications articles.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in piping applications articles.
- C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in piping applications articles.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in piping applications articles.
- E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in piping applications articles; raised ground face, and bolt holes spot faced.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

PART 3 - EXECUTION

3.1 LP STEAM PIPING APPLICATIONS

- A. LP Steam Piping: Schedule 40 Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- B. Condensate Piping above Grade: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless otherwise indicated.

- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- K. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) full port-ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
- M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- O. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
- P. Install unions in piping, NPS 2 (DN 50) smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- Q. Install shutoff valve immediately upstream of each dielectric fitting.
- R. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and full port ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2 (DN 50).

3.3 STEAM AND CONDENSATE PIPING SPECIALTIES INSTALLATION

- A. Comply with requirements in Section 232216 "Steam and Condensate Piping Specialties" for installation requirements for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for installation of hangers and supports. Comply with requirements below for maximum spacing.

- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
- C. Install hangers for steel steam supply piping with the following maximum spacing:
 - 1. NPS 3/4 (DN 20): Maximum span, 9 feet (2.7 m).
 - 2. NPS 1 (DN 25): Maximum span, 9 feet (2.7 m).
- D. Install hangers for steel steam condensate piping with the following maximum spacing:
 - 1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m).
 - 2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m).
- E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe 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 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.
- D. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install traps and control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install vacuum breakers downstream from control valve, close to coil inlet connection.
- E. Install a drip leg at coil outlet.

3.7 FIELD QUALITY CONTROL

- A. Prepare steam and condensate piping according to ASME B31.1, "Power Piping," and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush system with clean water. Clean strainers.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
- B. Perform the following tests and inspections:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
 - 3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
- C. Prepare test and inspection reports.

END OF SECTION 232213

SECTION 232216 - STEAM AND CONDENSATE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following piping specialties for LP steam less than 15 psig (104 kPa) and condensate piping:
 - 1. Strainers.
 - 2. Safety valves.
 - 3. Pressure-reducing valves.
 - 4. Steam traps.
 - 5. Thermostatic air vents and vacuum breakers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pressure-reducing and safety valve.
 - 2. Steam trap.
 - 3. Air vent and vacuum breaker.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Safety valves and pressure vessels shall bear the appropriate ASME label.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
 - 1. LP Steam Piping: 15 psig.
 - 2. Condensate Piping: 15 psig.
 - 3. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.

2.2 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping."
- B. Stop-Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements:
 - a. A.Y. McDonald Mfg. Co.
 - b. Cincinnati Valve Company.
 - c. Crane Co.
 - d. Jenkins Valves.
 - 2. Body and Bonnet: Malleable iron.
 - 3. End Connections: Flanged.
 - 4. Disc: Cylindrical with removable liner and machined seat.
 - 5. Stem: Brass alloy.
 - 6. Operator: Outside screw and yoke with cast-iron handwheel.
 - 7. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
 - 8. Pressure Class: 250.

2.3 STRAINERS

- A. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for strainers NPS 2 (DN 50) and smaller; flanged ends for strainers NPS 2-1/2 (DN 65) and larger.
 - 3. Strainer Screen: Stainless-steel, 20-mesh strainer, or perforated stainless-steel basket.
 - 4. Tapped blow-off plug.
 - 5. CWP Rating: 250-psig (1725-kPa) working steam pressure.

2.4 STEAM TRAPS

- A. Float and Thermostatic Traps:
 - 1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. Barnes & Jones, Inc.
 - c. Dunham-Bush, Inc.
 - d. Hoffman Specialty.
 - e. Spirax Sarco, Inc.
 - f. Sterling.
 - 2. Body and Bolted Cap: ASTM A 126, cast iron.
 - 3. End Connections: Threaded.
 - 4. Float Mechanism: Replaceable, stainless steel.
 - 5. Head and Seat: Hardened stainless steel.
 - 6. Trap Type: Balanced pressure.
 - 7. Thermostatic Bellows: Stainless steel or monel.

8. Thermostatic air vent capable of withstanding 45 deg F (25 deg C) of superheat and resisting water hammer without sustaining damage.
9. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless-steel cage, valve, and seat.
10. Maximum Operating Pressure: 125 psig (860 kPa).

B. Vacuum Breakers:

1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. Dunham-Bush, Inc.
 - c. Hoffman Specialty.
 - d. Johnson Corporation (The).
 - e. Spirax Sarco, Inc.
2. Body: Cast iron, bronze, or stainless steel.
3. End Connections: Threaded.
4. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
5. O-Ring Seal: EPR.
6. Pressure Rating: 125 psig (861 kPa).
7. Maximum Temperature Rating: 350 deg F (177 deg C).

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.
- B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.2 PIPING INSTALLATION

- A. Install piping to permit valve servicing.
- B. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) full port-ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- C. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
- D. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- E. Install shutoff valve immediately upstream of each dielectric fitting.

3.3 STEAM-TRAP INSTALLATION

- A. Install steam traps in accessible locations as close as possible to connected equipment.
- B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.4 TERMINAL EQUIPMENT CONNECTIONS

- A. Install traps and control valves in accessible locations close to connected equipment.
- B. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- C. Install vacuum breakers downstream from control valve, close to coil inlet connection.

END OF SECTION 232216

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rectangular ducts and fittings.
 - 2. Sheet metal materials.
 - 3. Sealants and gaskets.
 - 4. Hangers and supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: [G60 (Z180)] [G90 (Z275)].
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch (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).

2.3 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: [3 inches (76 mm)] [4 inches (102 mm)] [6 inches (152 mm)].
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 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.

6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

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 ducts with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

3.2 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."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.

3.4 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 (100 mm) thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (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 Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 DUCT CLEANING

- A. Clean existing duct system(s) before testing, adjusting, and balancing.
- B. 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.
- C. 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.

3.7 DUCT SCHEDULE

A. Supply Ducts/Outside Air Ducts:

1. Ducts Connected to Fan Coil Units
 - a. Pressure Class: Positive 1-inch wg (250 Pa).
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.

END OF SECTION 233113

SECTION 238113 - PACKAGED TERMINAL AIR-CONDITIONERS

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 packaged terminal air conditioners and their accessories and controls, in the following configurations:
 - 1. Through-the-wall and freestanding air conditioners.
 - 2. Cooling units with electric heat.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, electrical characteristics, and accessories.
- B. Shop Drawings: For packaged terminal air conditioners. Include plans, elevations, sections, details for wall penetrations and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Color Samples: For unit cabinet, discharge grille, and exterior louver, and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for packaged terminal air conditioners.
- B. Field quality-control reports.
- C. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged terminal air conditioners to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1

1.7 COORDINATION

- A. Coordinate layout and installation of packaged terminal air conditioners and wall construction with other construction that penetrates walls or is supported by them.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged terminal air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than five years from date of Substantial Completion, including components and labor.
 - 2. Warranty Period for Nonsealed System Parts: Manufacturer's standard, but not less than five years from date of Substantial Completion, including only components and excluding labor.
 - 3. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation; a United Technologies company.
 - 2. McQuay International.
 - 3. Trane; a business of American Standard Companies.

2.2 GENERAL

- A. Description: Factory-assembled and -tested, self-contained, packaged terminal air conditioner with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with hardwired chassis.
- B. The units shall be located as shown on the drawings and each shall include a wall box, room cabinet, separate cooling chassis, heating section, separate control box, and outdoor louver.

- C. All units shall be UL and CSA listed for safety and ARI certified for capacity and performance.
- D. Units shall be designed to operate on 208 volts, 60 Hz, single-phase power.
- E. The minimum energy efficiency ratio (EER) in Btu per hour per watt for each packaged incremental comfort conditioner must be 8.0 for all sizes. and dynamically balanced to provide for quiet and smooth operation.
- F. The indoor/evaporator fan motor shall be two speed, permanent split capacitor, totally enclosed and permanently lubricated with external oilers for prolonged life. Built-in overload protection shall come standard with the motor.
- G. During the heating cycle, only the indoor/evaporator fan motor and electric resistance heaters are energized. The outdoor/condenser fan motor and compressor shall not be energized. Heaters shall be open wire type with quick response and high limit cutout. Electric resistance heaters shall be sized to meet heating requirements as shown on the schedule.
- H. Electric resistance heaters must not be visible or accessible through the indoor discharge grill. An electrical junction box shall be furnished for connection to field supplied power source. Additionally, a disconnect plug shall be factory installed for quick connection to the control box.

2.3 COOLING CHASSIS

- A. Cooling chassis shall be slide-in, plug-in with a self-contained, hermetically sealed refrigerant circuit.
- B. All chassis sheet metal parts shall be constructed of heavy-gauge steel and coated with oven baked epoxy powder paint for maximum corrosion protection.
- C. The chassis shall be insulated with a waterproof material to prevent sweating and reduce sound levels.
- D. The cooling chassis shall consist of the following components:
 - 1. Vibration isolated, permanent split capacitor, rotary-type compressor with built in thermal overload.
 - 2. Rifled copper tubed evaporator (indoor) and condenser (outdoor) coils with high efficiency raised lance aluminum plate fins mechanically expanded to the tubes for maximum heat transfer.
 - 3. Capillary restrictor type refrigerant metering device supplemented with a constant pressure automatic expansion valve.
- E. Coils shall be factory tested at 300 psig.
- F. Condenser airflow system shall consist of a separate, single speed PSC motor with an aluminum blade centrifugal fan. The motor shall be totally enclosed and permanently lubricated with external oilers for prolonged life. The fan shall be forward curved and statically and dynamically balanced to provide for quiet and smooth operation.
- G. The cooling chassis shall also be furnished with a positive closing, automatic, motorized outdoor air damper that opens whenever the indoor fan is energized, except during night setback operation. A toggle switch shall be provided for manual override of the damper.
- H. During the cooling cycle, the compressor and both the outdoor/condenser and indoor/evaporator fan motors shall be energized. Condensation accumulated in the

indoor/evaporator drain pan shall be drained into the outdoor section of the unit where it is to be completely removed by evaporation. Evaporation shall be accomplished by uniformly distributing the condensate over the condenser coil via airflow generated by the outdoor/condenser fan. Condensate shall not come in contact with fan or fan motor. Slinger rings and propeller fans are not an acceptable solution for condensate removal.

2.4 HEATING SECTION

- A. The heat section shall be separate from the cooling chassis and shall incorporate an indoor/evaporator fan assembly. This assembly shall consist of two centrifugal fans that are forward curved and constructed out of aluminum with steel hubs and directly connected to a two-speed motor. Fans shall be statically

2.5 CONTROL BOX

- A. The control box shall be a separate component with plug-in connections to the heating section and cooling chassis.
- B. A concealed switch shall be furnished to automatically cycle or provide constant operation of the indoor fans.
- C. When placed in "Cycle" mode, the indoor/evaporator fans shall be automatically controlled by the thermostat when the HEAT, COOL, or FAN modes are selected. When placed in "Constant" mode, the fan shall run continuously except when the "STOP" button is depressed.
- D. The control overlay must be designed for the visually-impaired by containing large, raised function indicators and colorcoded selector buttons placed on a white polycarbonate membrane. Raised function indicators must conform to standards set by the National Federation of the Blind and comply with the federally mandated American Disabilities Act (ADA).

2.6 ROOM CABINET

- A. The room cabinet shall be made of heavy-gauge steel and coated with oven baked polyurethane powder paint for maximum protection.
- B. To accommodate various wall opening locations and floor irregularities, an adjustable kickplate shall be furnished with a standard adjustment of +/- 1". A removable front panel shall be supplied for service access of the filter, electrical connections, cooling chassis and heat section.
- C. Hidden latches shall be provided to prevent unauthorized personnel from removing the front panel. Indoor air discharge grilles shall be equipped with four-way positional stamped steel or extruded Aluminum covered with an oven baked epoxy powder paint for maximum protection.

2.7 FILTRATION

- A. Filtration shall be accomplished using a permanent, cleanable aluminum wire mesh filter.

2.8 WALL BOX

- A. The wall box shall be constructed from 16-gauge steel and welded for strength and durability. Once assembled, the wall box shall be coated with an oven baked epoxy powder paint to assure maximum corrosion protection.

2.9 OUTSIDE AIR LOUVER

- A. Outside air louvers shall be stamped or extruded architectural anodized aluminum as shown on plans.
- B. Louver shall be factory painted antique ivory color as manufactured by McQuay International or alternate manufacturers equivalent.
- C. Stamped louvers shall be heavy gauge anodized aluminum of no less than 16 gauge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install wall sleeves in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

3.2 CONNECTIONS

- A. Install piping adjacent to machine to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 2. After installing packaged terminal air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- C. Packaged terminal air conditioners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Perform startup service.
- B. After installation, verify the following:
 - 1. Unit is level on base and is flashed in exterior wall.
 - 2. Unit casing has no visible damage.
 - 3. Compressor, air-cooled condenser coil, and fans have no visible damage.
 - 4. Labels are clearly visible.
 - 5. Controls are connected and operable.
 - 6. Shipping bolts, blocks, and tie-down straps are removed.
 - 7. Filters are installed and clean.
 - 8. Drain pan and drain line are installed correctly.
 - 9. Electrical wiring installation complies with manufacturer's submittal and installation requirements in electrical Sections.
 - 10. Installation. Perform startup checks according to manufacturer's written instructions, including the following:
 - a. Lubricate bearings on fan.
 - b. Check fan-wheel rotation for correct direction without vibration and binding.
- C. After startup service and performance test, change filters.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain packaged terminal air conditioners.

END OF SECTION 238113

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set(s) for each air-handling unit.
 - 2. Gaskets: One set(s) for each access door.
 - 3. Fan Belts: One set(s) for each air-handling unit fan.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five years from date of Substantial Completion.
 - b. For Parts: Five years from date of Substantial Completion.
 - c. For Labor: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
 - 2. Koldwave, Inc.; a Mestek company.
 - 3. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
 - 4. SANYO North America Corporation; SANYO Fisher Company.
 - 5. Trane; a business of American Standard companies.
 - 6. YORK; a Johnson Controls company.

2.2 INDOOR UNITS 5 TONS (18 kW) OR LESS

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Enclosure Type: Totally enclosed, fan cooled.
 - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - f. Mount unit-mounted disconnect switches on interior of unit.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans:
 - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 1 inch (25 mm) deep.
 - b. Single-wall, stainless-steel sheet.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1 (DN 25).
7. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
 - b. Disposable Panel Filters:
 - 1) Factory-fabricated, viscous-coated, flat-panel type.
 - 2) Thickness: 1 inch (25 mm).

2.3 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.
3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.
5. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
1. Compressor time delay.
 2. 24-hour time control of system stop and start.
 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 4. Fan-speed selection including auto setting.
- B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- C. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports.
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238236 - FINNED-TUBE RADIATION HEATERS

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 steam, finned-tube radiation heaters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include details and dimensions of custom-fabricated enclosures.
 - 4. Indicate location and size of each field connection.
 - 5. Indicate location and arrangement of piping valves and specialties.
 - 6. Indicate location and arrangement of integral controls.
 - 7. Include enclosure joints, corner pieces, access doors, and other accessories.

PART 2 - PRODUCTS

2.1 STEAM FINNED-TUBE RADIATION HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Slant/Fin Corporation.
 - 2. Sterling Hydronics; a Mestek company.
 - 3. Trane Inc.
- B. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."
- C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled.

- D. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.
- E. Front Panel: Minimum 0.0428-inch- (1.1-mm-) thick steel.
- F. Wall-Mounted Back Panel: Minimum 0.0329-inch- (0.85-mm-) thick steel, full height, with full-length channel support for front panel without exposed fasteners.
- G. Support Brackets: Locate at maximum 36-inch (914-mm) spacing to support front panel and element.
- H. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.
- I. Damper: Knob-operated internal damper at enclosure outlet.
- J. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches (150 by 175 mm), integral with enclosure.
- K. Enclosure Style: Sloped Flat top.
 - 1. Front Inlet Grille: Punched louver; painted to match enclosure.
 - 2. Outlet Grille: Punched louver; painted to match enclosure.
- L. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for steam-piping connections to verify actual locations before installation of finned-tube radiation heaters.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FINNED-TUBE RADIATION HEATER INSTALLATION

- A. Install units level and plumb.
- B. Install enclosure continuously around corners, using outside and inside corner fittings.
- C. Join sections with splice plates and filler pieces to provide continuous enclosure.
- D. Install access doors for access to valves.
- E. Install enclosure continuously from wall to wall.
- F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

- G. Install valves within reach of access door provided in enclosure.
- H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.
- I. Install piping within pedestals for freestanding units.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 Steam and Condensate Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water finned-tube radiation heaters and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."
 - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Connect steam finned-tube radiation heaters and components to piping according to Section 232213 "Steam and Condensate Heating Piping" and Section 232216 Steam and Condensate Piping Specialties."
 - 1. Install shutoff valve on inlet; install strainer, steam trap, and shutoff valve on outlet.
- D. Install control valves as required by Section 230900 "Instrumentation and Control for HVAC."
- E. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 238236

SECTION 238239 – CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Propeller unit heaters.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of piping valves and specialties.
7. Indicate location and arrangement of integral controls.
8. Wiring Diagrams: Power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PROPELLER UNIT HEATERS

A. Manufacturers:

1. Basis-of-Design Product: Sterling.
2. Carrier Corporation; a UTC company.
3. McQuay International.
4. Trane Inc.

- 2.2 Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- A. Cabinet: Removable panels for maintenance access to controls.
 - B. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
 - C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
 - D. General Coil Requirements: Test and rate propeller unit heater coils according to ASHRAE 33.
 - E. Steam Coil: Copper tube, minimum 0.025-inch (0.635-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 75 psig (520 kPa).
 - F. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
 - G. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Type: Permanently lubricated.
 - H. Control Devices:
 - 1. Control interlock contactor for connection to building fire alarm system.
 - 2. Outdoor air damper and 24 volt interlock.
 - 3. Discharge air temperature sensor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Install propeller unit heaters level and plumb.
- C. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

- D. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."
- E. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Comply with safety requirements in UL 1995.
- E. Unless otherwise indicated, install union and gate or ball valve on steam-supply connection and union, strainer, steam trap, and gate or ball valve on condensate-return connection of unit heater. Steam specialties are specified in Division 23 Section "Steam and Condensate Heating Piping."
- F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 3. Provide a start up report to the owner.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 238239

SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all equipment, materials, labor and services necessary to furnish, install, test and turn over to the Owner the following electrical work as required by these specifications and as shown on the drawings, including all shop drawings, test reports, record drawings, operations and maintenance manuals, Owner training and incidental items necessary to complete the project in every respect.
- B. The work shall include, but not be limited to the following:
- Provision of a new Class A fully addressable fire alarm/voice evacuation system complete with fire alarm pull stations, smoke detectors, strobe flashers, speakers, combination speaker/visual flashers, and all associated items.
 - Provision of firefighter's two-way telephone communication system (i.e. phone jacks at stairwells, etc.).
 - All cutting, core drilling, patching, and painting required for installation of the new fire alarm system.
 - 120V power to fire alarm system panels and remote power supplies where required.
 - Renovations to existing inactive janitor closets (1 per floor) on floors 2 through 9 to facilitate their reuse as equipment closets to support the new fire alarm system wiring pathways.
 - Provision of 120/208V. 3 phase, 4 wire panelboards for branch power circuits to lighting, fire alarm and C&IT equipment.
 - Provision of all disconnect switches, fuses, etc. as required or indicated.
 - Provision of feeders to new lighting and receptacle panels.
 - Provision of all wireways, conduits, surface raceways, and associated fittings for all feeders and branch circuits as indicated or required.
 - Provision of all pull and junction boxes as indicated or required.
 - Provision of all building wiring and connections for all feeder and branch circuits as indicated or required.
 - Provision of dry type transformers as indicated.
 - Conduit sleeves through walls and floors as indicated on the drawings.
 - Prior to core drilling concrete floors, electrical trades shall test for the presence of existing building systems piping and electrical conduits using an impulse induction type scanner. Refer to Section 260100, Item 3.7 (E).

- Installation of new fire alarm system devices within the tenant apartments. (Coordinate installation schedule in advance with the owner's representative.)
- Testing and commissioning of new fire alarm system.
- Demolition of existing fire alarm system components in their entirety (following installation, testing, and approval of new fire alarm system). All existing fire alarm system components shall be stored following removal and turned over to the owner (i.e. manual pull stations, alarm bells, heat detectors, FACP and remote annunciator panels).
- Removal of existing corridor lighting fixtures, exit lights, and emergency egress battery lights as indicated on the drawings. (Removed items shall be returned to Owner.)
- Provide new light fixtures and exit lights as indicated on the drawings.
- Modify electrical service to building to provide feeder source for new fire pump per latest NEC/NFPA requirements.

C. Participate in project coordination and scheduling.

D. Commissioning Team:

The University Project Manager will establish a commissioning team to be assigned to this project. The team will perform construction observations during all phases of construction and monitor and document implementation of the commissioning sequence of all systems. The team will be responsible for the formal acceptance of each component of a system and the total system.

The members of the team will normally be drawn from the A/E, WSU Facilities Planning Management Department, WSU Office of Risk Management, Construction Manager, Subcontractors, and may include an Independent Commissioning Agent.

Commissioning Meetings:

The team meetings will be held regularly during the project. Commissioning meetings will be held separately from construction progress meetings. The Contractor and Subcontractors will be expected to attend the Owner's Commissioning Team meetings addressing system reviews.

A review of the commissioning needs of the project will be discussed at the construction kick-off meeting or an early construction meeting.

Responsibilities of the Contractor:

The Contractor shall be responsible to show in the project schedule the order and timing of the commissioning sequence for each of the project's systems.

Systems to be Commissioned:

The systems and equipment to be commissioned include, but are not limited to the following:

Fire detection and Alarm System:

Firefighter's two-way telephone communication system.

Commissioning Sequence:

Project commissioning is the responsibility of the Contractor. However, it is to be performed in concert with the Commissioning Team, which will verify the commissioning process by witnessing each commissioning activity. Verification will be performed by team members or by designated representatives.

It is important that testing of system components, subsystems and entire systems be completed in the proper order. Submit verification that testing of all systems, subsystems, or components required prior to the proposed system test have been successfully completed.

Example: Electrical systems are commissioned before electrical components of other systems are commissioned.

The following is a general outline of the commissioning sequence, whether formal or informal. It includes, but is not limited to the following items for each system, as applicable:

Submittal of shop drawings

Submittal of inspection certificates

Submittal of draft and final operations and training manual

Submittal of training plan

Submittal of start-up/installation materials

Installation and pretest

Test the functional performance of each complete system; testing each component and item of equipment through subsystems. Also, include the Department of Public Safety interface for fire alarm systems.

Any check or test which cannot be accomplished (for seasonal or other reason), or for which acceptable performance is not achieved, shall be rescheduled to a time when it can be accomplished.

Submittal of verification that all electrical systems testing has been completed.

Submittal of verification that check and test by manufacturer's representatives has been completed.

Participation in substantial completion walk-through.

Submittal of all warranties.

Submittal of "as-built" information.

Training sessions.

Assisting the WSU's Maintenance Department in understanding control of building systems.

Conclusion of Commissioning:

At the end of the commissioning process, every mode of systems operations, all system equipment, components and zones, and every item in the control sequence shall be proven operational under abnormal, emergency conditions, and all normal operational modes, including part-load and full-load conditions, where applicable.

Where seasonal conditions prevent commissioning at the time of project completion and turnover, an agreed upon schedule for commissioning when seasonal conditions allow shall be agreed upon in writing and made part of the project close out documents.

1.2 RELATED SECTIONS

- A. The drawings and the general provisions of the contract, apply to each section of the Divisions 26 and 28 specifications.

1.3 REFERENCES

- A. Provide equipment and materials that conform to the applicable standards of the following organizations:
 - 1. American National Standards Institute (ANSI).
 - 2. Institute of Electrical and Electronic Engineers (IEEE).
 - 3. National Electrical Manufacturers Association (NEMA).
 - 4. National Fire Protection Association (NFPA).
- B. All materials and equipment shall be listed and labeled by Underwriters Laboratories (UL), Electrical Testing Laboratories (ETL) or MET Laboratories (MET).
- C. Install equipment and materials in compliance with the following:
 - 1. National Electrical Code (NEC).
 - 2. Life Safety Code (NFPA-101).
 - 3. Michigan Building Code (MBC).
 - 4. Michigan Mechanical Code (MMC).
 - 5. State of Michigan DLEG Bureau of Fire Services.
 - 6. Owner's Inspection Authorities.
 - 7. Manufacturers' instructions.
 - 8. NFPA.
 - 9. ADA & Michigan Barrier Free.

10. Michigan Rehabilitation Code for Existing Buildings.
11. Michigan Fire Prevention Code.
12. MIOSHA Standards.

1.4 DESIGN DOCUMENTS

- A. Contact the Owner's Representative about design questions and discrepancies between design documents before performing the work.
- B. Notify the Owner's Representative if existing code violations are uncovered that are not addressed in the design documents.

1.5 SUBMITTALS

- A. Proposed Product List: Include products specified in the following sections:

Section 260100 – Basic Electrical Requirements.
Section 260500 – Basic Electrical Materials and Methods.
Section 260519 – Cables and Wires.
Section 260526 – Grounding.
Section 262200 – Low-Voltage Transformers.
Section 262416 – Panelboards.
Section 262816 – Enclosed Switches and Circuit Breakers
Section 265100 – Interior Lighting.
Section 269950 – WSU Preferred Manufacturers List.
Section 283111 – Digital, Addressable Fire-Alarm System.
- B. Submit for approval copies of shop drawings and product literature for the following equipment. Submittals shall include adequate information to prove that the systems, equipment and materials comply with the contract documents. Each copy of the submittals shall be marked to indicate the specific models, sizes, types and options being provided. Submittals not so marked will be rejected.
 1. Fire Alarm Systems equipment.
 2. Cable and Wires.
 3. Panelboards.
 4. Enclosed Switches and Circuit Breakers.
 5. Interior Lighting.
 6. Low-Voltage Transformers.
- C. Participate in the coordination drawing process and submit coordination drawings for approval.

1.6 RECORD DOCUMENTS

- A. Submit record drawings in electronic format (AutoCAD) for approval. Show the locations of equipment, riser information, the sizes of conduits and conductors, circuit numbers, and deviations from the design.

1.7 OPERATIONS AND MAINTENANCE MANUALS

- A. Submit for approval copies of operations and maintenance manuals. Each copy of the manuals shall be marked to indicate the specific models, sizes, types and options of the systems and equipment that were provided. Manuals not so marked will be rejected.

1.8 TRAINING

- A. Arrange for manufacturers to train The Owner's Personnel on the operation and maintenance of systems and equipment. Training shall not take place until Maintenance Personnel have been given 2 weeks to review the approved operations and maintenance manuals. Notify the Owner's Representative 3 working days in advance of training sessions.
- B. Walk the Owner's Maintenance Personnel through the project and identify the locations of electrical equipment hidden from plain view.
- C. Inform The Owner's Maintenance Personnel of changes to existing power distribution systems, fire alarm system and other special systems that could affect their maintenance activities.

1.9 QUALITY ASSURANCE

- A. Electrical work shall be performed by licensed Journeyman or registered Apprentice Electricians. The number of Apprentices on a project shall not exceed the number of Journeymen. Electricians shall carry a copy of their license or registration while working on The Owner's projects.
- B. Contact the Owner's Inspection Department before starting the project to arrange for periodic inspections. Normal inspections will be performed at no cost to the Contractor, but the costs for repeat re-inspections of rejected work may be deducted from the Contractor's final payment.

1.10 WARRANTY

- A. Guarantee work for a period of one year from the date of the Owner's final acceptance of the project (Substantial Completion). A manufacturer's warranty beginning upon equipment receipt or startup shall be extended to one year from final project acceptance. A manufacturer's warranty in excess of one year shall remain in effect for its entire time period.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 SUBSTITUTIONS

- A. Provide equipment and materials from the manufacturers specified. Substitutions for specified products are acceptable only if proposed and approved in writing at the time of bid.

3.2 ELECTRICAL COORDINATION

- A. All Contractors must obtain approval from the University Project Manager prior to interrupting existing services. All service interruptions shall be at a time approved by the University. Include specification language covering off hours tie-ins.

3.3 SHIPPING, HANDLING AND STORAGE

- A. For deliveries of equipment to the Owner, notify the Owner's Representative of the deliveries 3 working days in advance. Deliveries shall occur on normal workdays between 8:00 AM and 2:00 PM. Deliveries that arrive without adequate notice may be rejected.

3.4 DEMOLITION

- A. Protect adjacent building services and materials indicated to remain. Install and maintain barriers to keep dirt, dust and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition is completed.

3.5 CLEANUP

- A. Remove and legally dispose of demolished items, rubbish and debris from the construction site daily, and at the completion of the work. Failure to do so may result in the cleanup being performed by others and all costs thereof being deducted from the Contractor's final payment.

3.6 EQUIPMENT PROTECTION

- A. Protect equipment and materials during shipment, storage and construction against damage and contamination.
- B. Items that become damaged or contaminated shall be restored to a "like new" condition or replaced at the Contractor's expense.

3.7 WORK PERFORMANCE

- A. Locate equipment as close as practical to the locations shown on the drawings. Should field conditions prevent the installation of equipment or materials as indicated on the drawings, make any deviations only with the prior approval of the Owner's Representative.
- B. Install and connect new work to existing work neatly and carefully. Existing work that is disturbed shall be repaired or replaced as necessary to restore it to its prior condition.
- C. Coordinate to ensure completion consistent with the project schedule. Do not unduly delay the startup, testing or turnover of project systems.
- D. Coordinate work to ensure a safe working space around electrical equipment and to ensure access to equipment requiring maintenance. Working space and access shall be sufficient for an adult to perform maintenance tasks safely without straddling or removing obstructions. Electrical work that encroaches on working space or that impedes maintenance shall be relocated at the Contractor's expense.
- E. Prior to core drilling concrete floors, test for the presence of electrical conduits. Use an impulse induction type scanner capable of detecting both metallic conduits and copper wires in PVC conduits. Tracers that scan for energized cables or that scan for injected

high frequency signals are not acceptable. Notify the Owner's Inspection Department prior to all tests. Prior to core drilling, arrange for the Owner's Representative to notify building occupants of the potential for an unscheduled power outage. Conduits damaged during core drilling shall be restored immediately at the Contractor's expense.

3.8 EQUIPMENT AND WIRING IDENTIFICATION AND COLOR CODING

- A. Provide nameplates indicating equipment names or numbers and power sources as specified in Section 260500.
- B. Paint fire alarm system junction boxes and covers as specified in Section 260500.
- C. Conduits used for fire alarm system wiring shall be factory painted red: equal to "True Color" EMT as manufactured by Allied Tube & Conduit (size as indicated on drawings).
- D. Mark junction box covers with the panel and breaker numbers of the circuits contained within as specified in Section 260500.
- E. Color code and identify wiring in accordance with Section 260519

3.9 FIELD QUALITY CONTROL

- A. Arrange for testing of electrical systems, equipment and materials prior to final acceptance of the work. Acceptance tests shall be performed in accordance with Section 269500, and applicable codes, standards and manufacturers' instructions.
- B. Provide all test equipment, materials and labor necessary to perform the tests.
- C. Notify the Owner's Representative 3 working days in advance of tests. The Owner shall witness the tests unless the Owner's Representative waives such witnessing in writing.
- D. Notify manufacturers sufficiently in advance of tests for which the manufacturers should be present.
- E. Replace any equipment or materials found to be defective or found to be of lesser quality than that specified or shown on the drawings.
- F. Provide written test reports, signed and dated, for all tests prior to acceptance of the electrical equipment by the Owner.

END OF SECTION 260100

DIVISION 26 ELECTRICAL

SECTION 260500 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide conduits, surface raceways, boxes, fittings and supports to form a complete, coordinated, and continuously grounded raceway system.

1.2 CONDUIT REQUIREMENTS

- A. Install conduit in accordance with NFPA 70 "Standard of Installation".
- B. Conduits indoors in general areas shall be electrical metallic tubing (EMT) with steel set screw fittings.
- C. Conduits used for fire alarm system wiring shall be factory painted red: equal to "True Color" EMT as manufactured by Allied Tube & Condit (size as indicated on drawings).
- D. Conduits indoors in hazardous areas or subjected to water, physical damage or abuse shall be galvanized rigid steel (RS) or intermediate metal conduit (IMC) with cast or malleable iron threaded fittings and bushings.
- E. Connections to recessed junction boxes, in areas with accessible ceilings:
 - 1. In existing 'metal stud and gypsum board partitions (walls)', where the wall is not being otherwise opened up, the final connections to new devices may be made flexible conduit and standard (separate) conductors. This flexible conduit shall:
 - a. Be increased in size as necessary to maintain the proper fill for the wiring to be installed.
 - b. Shall be installed and secured as required by NEC.
 - c. Shall be as short as it is necessary to serve the need and meet the NEC.
 - 2. In all other wall types and conditions use standard conduit, of the type appropriate for the wall construction.

1.3 SURFACE RACEWAY REQUIREMENTS

- A. When conduits in finished areas cannot be concealed in walls or above ceilings, surface raceways may be used where permitted. Boxes and fittings shall match and be from the same manufacturer as the raceways.

1.4 BOX REQUIREMENTS

- A. Provide sheet steel outlet boxes, extensions, and plaster rings for EMT and flexible metal conduit.
- B. Provide cast or malleable iron outlet boxes and covers for galvanized rigid steel conduits, intermediate metal conduits, and liquid tight flexible metal conduits.

- C. Boxes shall be sized for all conductors and devices to be contained within. Box extensions shall not be used to correct for undersized boxes. A single extension may be used as follows only if all free conductors extend at least 3 inches outside of the extension opening.
 - 1. On existing boxes in walls that are being furred out.
 - 2. On existing boxes for connecting to an existing circuit.
 - 3. On fire alarm boxes where required by the system manufacturer's instructions.
- D. Plaster rings shall not be considered box extensions, but their capacities may be included in box fill calculations.

1.5 SUPPORT REQUIREMENTS

- A. Surface mounted equipment shall be secured to wall or structure. The equipment shall be attached with toggle bolts to hollow tile, block or similar surfaces, and attached with screws or bolts and expansion shields to solid masonry or concrete.

PART 2 - PRODUCTS

2.1 CONDUITS

- A. Electrical metallic tubing shall be thin wall steel tubing, electro-galvanized or hot dipped galvanized inside and outside. Fittings and bushings shall be galvanized steel set screw type with two screws per connection for sizes over 2".
- B. Galvanized rigid steel conduit and intermediate metal conduit shall be hot dipped galvanized inside and outside, in 10' lengths and threaded on both ends. Fittings and bushings shall be cast or malleable iron, and hot dipped galvanized inside and outside.
- C. Flexible metallic conduit shall be galvanized steel or aluminum. Fittings shall be of steel with cadmium or galvanized finish. Fittings shall be machine screw clamp type, single or two-piece. Self-locking, twist-in type fittings are not acceptable.
- D. Liquid tight flexible metallic conduit shall consist of a flexible, galvanized steel core, a continuous copper ground strip and a polyvinyl chloride jacket. Fittings shall be steel liquid tight grounding type from the same manufacturer as the conduit.

2.2 SURFACE RACEWAYS

- A. Where surface raceways are called for on the drawings, or when conduits in finished areas cannot be concealed in walls or above ceilings, surface raceways shall be used. Boxes and fittings shall match and be from the same manufacturer as the surface raceway.
- B. Surface raceways shall consist of a base and cover, sized for the number of conductors contained within, complete with all connectors, fittings, bushings, boxes, covers and mounting hardware.
- C. Raceways shall be 600 volt rated, and be in compliance with the applicable paragraphs of NEC Article 352.
- D. They shall be non-flammable, and UL labeled, under UL 5, or UL 5A (as applicable).

- E. The completed raceway system shall be vandal resistant.
- F. Surface raceways shall accept cover plates, fire alarm devices and other standard wiring devices as specified elsewhere in these specifications.
- G. The cover plates used for devices shall be of the 'overlapping' type, and shall therefore cover the 'cut-end' of the raceway cover.
- H. The raceways shall have a select ivory (or white, or gray to match wall finish) color, "scuff" resistant finish, and the raceways shall be paintable.
- I. All components of the raceway system exposed to view shall be of the same color and shade.
- J. Barriers shall be provided when necessary to separate conductors of different voltages, or services.
- K. Surface raceways shall be steel as noted below:
 - 1. Metallic
 - a. Metallic raceways shall be of .040" thick (minimum) zinc plated or galvanized steel.
 - b. The acceptable levels of quality are, generically,
 - 1. "Wiremold V500 and V700" for smaller single channel raceway applications,
 - 2. "Wiremold V3000" for larger single channel raceway applications, and
 - 3. "Wiremold V4000" for larger multi-channel raceway applications.
- L. Use vertical surface raceways from junction boxes above the ceiling, to the horizontal portion of the surface raceway. Locate vertical section as close to room corners (or 'vertical breaks' in mid wall) as is possible. Use of exposed vertical conduits is not acceptable.

2.3 BOXES

- A. Boxes for outlets, connections and wire pulling shall be:
 - 1. Cast or formed from carbon steel sheets of commercial grade steel not less than 14-gauge.
 - 2. One-piece construction, zinc, or cadmium plated.
 - 3. Tapped for mounting plates and covers as required.
- B. Pull and junction boxes shall be:
 - 1. Fabricated from galvanized or painted code gauge cold rolled carbon steel sheets.

2. Welded construction with flat removable covers fastened to the box with machine screws.
 3. Seams and joints shall be closed and reinforced with flanges formed of the same material from which the box is constructed or by continuous welding which will provide equivalent strength to flange construction.
 4. Preferably not provided with 'knockouts'.
- C. Box covers shall be fastened in place by machine screws or hinges and latches. Self-tapping or sheet metal fasteners are not acceptable.

2.4 SUPPORTS

- A. Hangers and brackets shall be made of steel pipe, channel iron, angle iron or prefabricated steel channel. Prefabricated steel channel shall be by B-Line, Hilti, Powerstrut or Unistrut.
- B. Anchors shall be lead shield anchors or plastic expansion anchors for small loads, and expansion or epoxy anchors for large loads. Power-driven anchors shall not be used.

2.5 LABELS AND DIRECTORIES

- A. Equipment nameplates shall be engraved .125 inch (1/8") thick lamicoid plastic. White, with black letters. The engraved letters shall be at least one quarter inch (1/4") high.
- B. Panel directories shall be neatly updated and typed on supplied card stock with panel, or card stock similar in thickness and material as those supplied with the panels.
- C. Arrange exposed conduits to maintain headroom and present neat appearance.

PART 3 - EXECUTION

3.1 RACEWAYS

- A. Size conduits in accordance with the NEC, but not less than the sizes shown on the drawings. Minimum power and control conduit size shall be 3/4". Minimum telecommunications conduit size shall be 3/4".
- B. Install concealed and exposed conduits parallel to or at right angles to building lines. Conduits shall not be embedded in concrete slabs except where specifically shown. Install surface raceways as close to room corners or trim features as possible to make the surface raceways less obvious.
- C. Conceal conduits wherever possible and practical. When conduits cannot be concealed in finished areas, use surface raceways with matching boxes from the same manufacturer as the raceways.
- D. Metal conduits, fittings, enclosures and raceways shall be mechanically joined together in a firm assembly to form a continuous electrical conductor providing effective electrical grounding continuity.
- E. Provide expansion fittings at the intervals specified in the manufacturer's instructions.

- F. Separate raceways from uninsulated steam pipes, hot water pipes, and other hot surfaces by a minimum of 4" horizontally or 12" vertically. Separate raceways from ventilation ducts and insulated pipes so that they do not come into contact with each other.
- G. Low voltage signal circuits shall be separated or shielded from power circuits to prevent the induction of noise into the signal circuits.
- H. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104°F.
- I. EMT entering sheet metal enclosures and outlet boxes shall be secured in place by a connector with a locknut. Rigid conduit shall be secured with locknut inside and outside and a bushing. Sufficient thread on the connector or conduit shall extend into the enclosure so that the bushing will butt tight into the connector or conduit. Bushings shall not be used as jamb nuts or in lieu of locknuts.
- J. Flexible metallic conduit to motors and similar equipment shall not exceed 3'-0" in length, and shall have adequate slack to absorb the maximum vibration.
- K. Install no more than the equivalent of three (3) 90° bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inch size.

3.2 MOUNTING HEIGHTS

- A. Except where shown otherwise, install equipment and devices at the following heights:
 - 1. Fire Alarm Pull Stations: 48" A.F.F. to center
 - 2. Fire Alarm Audible/Visual: 80" A.F.F. to bottom
 - 3. Panels: 72" A.F.F. to top

3.3 SUPPORTS

- A. Support all electrical items independently of supports provided by the other trades.
- B. Support conduits and boxes using coated steel or malleable iron conduit straps or 1/4-inch minimum diameter threaded rod hangers. Suspended ceiling hangers or hanger wire shall not be used (except to support flexible metallic conduit and manufactured wiring systems).
- C. Route metallic conduit and manufactured wiring systems parallel to or perpendicular to building lines, and in a neat and workmanlike manner.

3.4 PENETRATIONS, SLEEVES AND FIRE SEALS

- A. Cut floor and wall penetrations neatly and to the minimum size required for installation of the equipment and raceways.
- B. Provide galvanized steel pipe sleeves equivalent to Schedule 40 wall thickness for all conduits penetrating floors, exterior walls and roofs.

1. Extend floor sleeves above floor a minimum of two (2) inches.
 2. Embed sleeves in new concrete or step-core concrete and grout sleeves into existing concrete with epoxy grout. Sleeves shall be sized to provide 1/2" clearance between the outside surfaces of the item in which they are installed.
 3. Seal floor sleeves using fire-sealing systems approved by a Nationally Recognized Testing Laboratory and as detailed in UL Fire Resistant Directory, Volume 2, latest edition. The filler materials and methods used shall be rated at least equal to the fire resistance of the material being penetrated.
 4. Sleeves shall be flush with walls unless otherwise indicated.
- C. Patch both sides of wall penetrations cut for electrical equipment and raceways to seal against the passage of air, sound and fire.
1. Seal conduit penetrations in fire rated walls using fire-sealing caulk approved by a Nationally Recognized Testing Laboratory.
 2. Seal conduit penetrations in non-rated walls using masonry materials that match the wall construction.
 3. Fire seal between recessed outlet boxes located on opposite sides of a fire rated wall if the box openings are over 16 square inches and the boxes are less than 24 inches apart.

3.5 EXPANSION FITTINGS

- A. Provide expansion fittings at all building expansion joints. Expansion fittings shall be bonded to the raceway on both sides.
- B. Provide expansion fittings, in accordance with manufacture recommendations, in all areas subject to swings in temperature of more than 15 degrees C.
- C. Install expansion fittings in all locations where expected expansion difference is 1/4", or more, between boxes

3.6 IDENTIFICATION

- A. Provide nameplates and labels in accordance with Article 2.5.
 1. Lamicoid labels shall be mechanically secured in place with sheet metal screws and/or bolts and nuts
 2. Labels shall be neatly centered. Place labels in like positions on similar equipment.
- B. Color code wiring as noted in Section 260519.
- C. Color code junction boxes and box covers of fire alarm circuits with red paint.
- D. Mark junction box covers in indelible ink with the panel and breaker numbers of the circuits contained within.

END OF SECTION 260500

DIVISION 26 ELECTRICAL

SECTION 260519 - CABLES AND WIRES

PART 1 - GENERAL (NOT APPLICABLE)

PART 2 - PRODUCTS

2.1 CABLE AND WIRE (600 VOLTS AND BELOW)

- A. Wire for above ground use shall be single conductor stranded copper, No. 12 AWG minimum, with NEC Type THHN insulation rated 90 degrees C, 600 volts.
- B. Exposed feeders (fire pump service, indoors): mineral-insulated, metal-sheathed cable, type MI.
- C. Control cable shall be single conductor stranded copper No. 14 AWG minimum; with NEC Type THHN insulation rated 90 degrees C, 600 volts.
- D. Instrumentation and special systems wire shall be in accordance with manufacturers' recommendations, but shall not be less than 20 AWG.

2.2 BUILDING WIRE AND CABLE

- A. All wire/cable shall be 98% copper minimum.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Make wiring connections using wire and cable with insulation suitable for temperature encountered in heat producing equipment.
- B. Install all cables and wires (including telecommunications, low voltage control and power limited circuits) in raceways. Telecommunications raceways shall be continuous from outlet boxes to telecommunications rooms.
- C. Segregate wiring of different voltage levels. Circuits operating at different voltages shall not share raceways.
- D. Splice branch circuit wiring, and control and instrumentation wiring with wire nut connectors. Terminate control and instrumentation wiring with solderless compression ring or spade lugs. Compression connectors and lugs shall be crimped with tools specifically designed for the terminations being crimped.
- E. Color code circuits as follows:
 - 1. Fire Alarm Wiring:
 - Addressable Initiating Device: #18 Shielded Twisted
 - Pair (STP) Red with Black Stripe
 - Audio, Audio/Visual or Controlled Output Positive (+) 24

VDC: #14 Red

Audio, Audio/Visual or Controlled Output Negative (-) 24

VDC: #14 Black

Strobe Light Positive (+): #14 Solid Yellow

Strobe Light Negative (-): #14 Solid Blue

Panel Communications: #18 STP Red with Black Stripe

- E. Provide home runs of No. 10 AWG wire for 20 amp branch circuits that exceed 150' in length.
- F. Ground the shields of shielded instrumentation and control cables at one end only. The shields at the other end shall be insulated from ground.
- G. Provide identification tags on all cables and conductors terminated in panels.

3.2 FIELD QUALITY CONTROL

- A. Perform testing in accordance with Section 269500 and submit test reports.

END OF SECTION 260519

DIVISION 26 ELECTRICAL

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide grounding in accordance with the requirements of the NEC and University Inspection Authorities.
- B. The resistance of the completed ground system for standard installations shall not exceed 5 ohms. If any special equipment being installed requires a lower ground system resistance, that equipment manufacturer's maximum ground resistance shall apply.

1.2 MATERIAL REQUIREMENTS

- A. Ground conductors for all power distribution equipment, end-use equipment and all branch circuits, shall be insulated stranded copper conductors, color coded green or (a continuous) green color with 1 or more yellow stripes. The size shall be in accordance with NEC, except that none shall be smaller than No. 12 AWG.

1.3 REQUIREMENTS

- A. A separate grounding conductor shall be used for all new branch circuits.
- B. Conduit shall not be used as the ground conductor.
- C. Ground instrumentation and electronic devices in accordance with the NEC or the manufacturer's recommendations, whichever is stricter.
- D. Conduits and all other raceways shall be grounded/bonded in accordance with the NEC.
- E. The shields of shielded instrumentation cables shall have their drain wires grounded at one end only. The shield at the other end of the cables shall be isolated from ground.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with ~~9/16-inch-~~ (14-mm-) diameter holes at a maximum of ~~8 inches~~ (200 mm) o.c., in at least 1 surface.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.

- c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
- 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
- 4. Fitting and Accessory Materials: Same as channels and angles.
- 5. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. 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:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated and stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. 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:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be **1/4 inch (6 mm)** in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for **1-1/2-inch (38-mm)** and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus **200 lb (90 kg)**.

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete **4 inches (100 mm)** thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than **4 inches (100 mm)** thick.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts [Spring-tension clamps].
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of **2.0 mils (0.05 mm)**.
- B. Touchup: Comply with requirements in Division 9 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND TUBING

- 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. AFC Cable Systems, Inc. Triangle PWC.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 3. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. EMT: ANSI C80.3.
- E. FMC: Zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel, Steel or die-cast, set-screw or compression type.
- H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.02 METAL WIREWAYS

- 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. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.03 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Prime coating, ready for field painting.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
 - d. Mono-Systems.

2.04 BOXES, ENCLOSURES, AND CABINETS

- 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. EGS/Appleton Electric.
 - 2. Hoffman.
 - 3. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 4. O-Z/Gedney; a unit of General Signal.
 - 5. RACO; a Hubbell Company.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy and aluminum, Type FD, with gasketed cover.
- D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- H. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.05 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.06 SLEEVE SEALS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- C. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: Rigid steel conduit.
 3. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 4. Damp or Wet Locations: Rigid steel conduit.

5. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway, EMT.
 6. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: Plenum-type, optical fiber/communications cable raceway, EMT.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size except of switch legs may be ½ inch.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.02 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
1. **3/4-Inch (19-mm)** Trade Size and Smaller: Install raceways in maximum lengths of **50 feet (15 m)**.
 2. **1-Inch (25-mm)** Trade Size and Larger: Install raceways in maximum lengths of **75 feet (23 m)**.
 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed **30 deg F (17 deg C)**, and that has straight-run length that exceeds **25 feet (7.6 m)**.
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: **125 deg F (70 deg C)** temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: **155 deg F (86 deg C)** temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: **125 deg F (70 deg C)** temperature change.
 - d. Attics: **135 deg F (75 deg C)** temperature change.
 2. Install fitting(s) that provide expansion and contraction for at least **0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C)** of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- O. Flexible Conduit Connections: Use maximum of **72 inches (1830 mm)** of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- Q. Set metal floor boxes level and flush with finished floor surface.

3.03 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level.
- G. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

3.04 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Warning labels and signs.
 - 4. Equipment identification labels.
 - 5. Miscellaneous identification products.

1.03 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.04 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.05 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.02 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

2.03 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.04 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.05 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange self-adhesive vinyl label.
- B. Power-Circuit Conductor Identification: For secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- E. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with ~~1/2-inch-~~ (13-mm-) high letters on ~~1-1/2-inch-~~ (38-mm-) high label; where 2 lines of text are required, use labels ~~2 inches~~ (50 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Disconnect switches.
 - c. Enclosed circuit breakers.
 - d. Motor starters.

- e. Push-button stations.

3.02 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION 260553

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1.03 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- B. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.06 COORDINATION

- A. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Eaton Electrical Inc.; Culter-Hammer Products.
 - 2. Square D; Schneider Electric.
 - 3. General Electric.

2.02 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Copper.

2.03 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- E. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- F. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.

2.04 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.05 VIBRATION MOUNTINGS

- A. Description: Vibration isolators and mounting rails to isolate transformer from structure, reducing transmitted noise.
- B. Vibration Isolators for Floor Mounted Transformers: Provide steel housed open spring isolators seated in rubber with provisions for leveling and bolting to mounting rails and concrete base or wall brackets.
- C. Mounting Rails: Provide steel channels. To insure adequate stiffness, height of channel shall be a minimum of 8 percent of longest channel dimension.
- D. Vibration isolator manufacturer shall select units suitable for transformers indicated. Vibration isolator manufacturer shall determine quantity of units, but not less than four per transformer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions.
- B. Install distribution transformers 15 KVA and larger on vibration mountings.

3.03 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding".
- B. Connect wiring according to Division 26 Section "Cables and Wires".

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.05 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.06 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.

1.03 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
- C. Qualification Data: For qualified testing agency.
- D. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

- E. Panelboard Schedules: For installation in panelboards typewritten.
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NECA 407.

1.06 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.08 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 6. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 - 7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover. Directory to be typewritten.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
 5. Split Bus: Vertical buses divided into individual vertical sections.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.
- C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- D. Mains: Circuit breaker or lugs only.
- E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

- F. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.
- G. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.03 LOAD CENTERS

- A. Load centers will not be acceptable.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Square D; a brand of Schneider Electric.
- C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.

- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.
- B. Mount panelboard cabinet plumb and rigid without distortion of box.
- C. Install overcurrent protective devices not already factory installed.
- D. Install filler plates in unused spaces.
- E. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- F. Comply with NECA 1.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION 262416

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. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Snap switches.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

- 1. Hubbell.
- 2. Pass & Seymour.
- 3. Bryant.

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hubbell; HBL5351 (single), CR5352 (duplex).
 - b. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, [feed] [non-feed]-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pass & Seymour; 2084.

2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - b. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.5 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Satin-finished stainless steel.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations".
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.6 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than **6 inches (152 mm)** in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Cartridge fuses rated 600 V and less for use in switches, panelboards, switchboards, controllers and motor-control centers.

1.03 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 2. Let-through current curves for fuses with current-limiting characteristics.
 - 3. Time-current curves, coordination charts and tables, and related data.
 - 4. Fuse size for elevator feeders and elevator disconnect switches.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

1.05 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.06 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.

PART 2 - PRODUCTS

2.01 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. Cooper Bussman, Inc.
 - 2. Ferraz Shawmut, Inc.
 - 3. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

- A. Feeders: Class RK5, time delay.
- B. Motor Branch Circuits: Class RK5, time delay.
- C. Other Branch Circuits: Class RK5, time delay.

3.03 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.04 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.

1.03 DEFINITIONS

- A. GD: General duty.
- B. HD: Heavy duty.

1.04 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. UL listing for series rating of installed devices.
 - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.07 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.02 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Square D/Group Schneider.

- B. Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
 - 3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Infrared Scanning:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.
 - b. Follow-Up Infrared Scanning: Perform an additional follow-up infrared scan of each unit 11 months after date of Substantial Completion.
 - c. Instruments, Equipment and Reports:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2) Prepare a certified report that identifies enclosed switches and circuit breakers included and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262816

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Exit signs.

1.03 DEFINITIONS

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. HID: High-intensity discharge.
- D. LER: Luminaire efficacy rating.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.04 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Ballast.
 - 3. Energy-efficiency data.
 - 4. Life, output, and energy-efficiency data for lamps.
 - 5. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
 - 1. Wiring Diagrams: Power and control wiring.
- C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.06 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.07 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

- B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
- C. Special Warranty for T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.02 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.

G. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
 - b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

H. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.03 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. Electronic Ballasts: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
1. Sound Rating: A.
 2. Total Harmonic Distortion Rating: Maximum 10 percent.
 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 4. Operating Frequency: 42 kHz or higher.
 5. Lamp Current Crest Factor: 1.7 or less.
 6. BF: 0.85 or higher.
 7. Power Factor: 0.98 or higher.
 8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

2.04 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: A.
 4. Total Harmonic Distortion Rating: Maximum 10 percent.
 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher, unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
 10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 11. Ballast Case Temperature: 75 deg C, maximum.

2.05 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: Fluorescent, 2 for each fixture, 20,000 hours of rated lamp life.
 - 2. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 - 3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.06 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 80 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated.
- B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 80 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

2.07 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than **6 inches (150 mm)** from lighting fixture corners.
 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two **3/4-inch (20-mm)** metal channels spanning and secured to ceiling tees.
 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 265100

DIVISION 26 ELECTRICAL

SECTION 269500 - ELECTRICAL ACCEPTANCE TESTS

PART 1 - GENERAL

1.1 TESTS

- A. Perform the visual inspections, manual operations and tests on systems and equipment as described in Part 3, "Execution".
- B. Tests shall be performed and documented by an independent testing agency.

1.2 TEST REPORTS

- A. Provide written test reports, signed and dated, for all tests prior to acceptance of the tested equipment by the Owner.

PART 2 - PART 2 -PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 VISUAL INSPECTIONS

- A. Prior to any testing, perform visual inspections to verify the following:
 - 1. The equipment is completely and properly installed.
 - 2. The equipment is free from damage and defects.
 - 3. Shipping blocks and restraints have been removed.
 - 4. Electrical terminations have been properly tightened.
 - 5. The equipment has been properly aligned.
 - 6. The equipment is ready to be tested.
 - 7. The equipment complies with the contract documents and the shop drawing submittals.
 - 8. The equipment is completely and properly installed according to the contract documents and the manufacturer's instructions.
 - 9. Adequate working space exists around the equipment to fully open doors and access panels, and to access all components that require maintenance.
 - 10. Terminations have been identified.
 - 11. Equipment labels have been installed.

3.2 CONTROL CABLE TESTS

- A. Perform a continuity check on control and instrumentation wiring.

3.3 FIRE ALARM SYSTEMS

- A. Perform testing in accordance with NFPA 72-2011, Chapter 7.
- B. Controls that interface with the fire alarm system shall be tested to insure proper operation of interfaced mechanical devices.
- C. Alarm, supervisory, and trouble outputs shall be tested to insure that the signals are received by WSU Public Safety.

END OF SECTION 269500

DIVISION 26 ELECTRICAL

SECTION 269950 – WSU PREFERRED MANUFACTURERS LIST

PART 1 - GENERAL

1.1 PREFERRED MANUFACTURERS LIST

- A. The Preferred Manufacturers List identifies manufacturers known to provide good quality products, meet specification and schedule requirements, provide technical support before and after the sale and provide service after installation. This list identifies frequently specified manufacturers only. It is intended to establish a standard of quality, and it shall not be construed as limited competition.
- B. This list shall be used when selecting products in construction.
- C. This list shall not be used by contractors to justify substitutions for products specified in the construction documents. ANY SUBSTITUTION FOR A SPECIFIED PRODUCT MUST BE APPROVED BY THE UNIVERSITY IN ADVANCE. A contractor requesting approval of a substitution shall do so only at the time of bid through the University Design and Construction Standards Committee.
- D. This list does not apply to the purchase of replacement or retrofit products needed to match or maintain existing installations.
- E. Note: All provided products shall have a manufacturing date within one (1) year from date of bidding or installation.

<u>Equipment</u>	<u>Manufacturers</u>
Metal Conduit	Triangle PWC, Wheatland, Allied Steel Conduit
Liquid Tight Flexible Metal Conduit	AFC, Electri-FlexCo, O.Z. Gedney
Electrical Metallic Tubing (EMT)	Triangle PWC, Wheatland, Allied Steel Conduit
Conductor	Southwire, Triangle, Rome, Cablec
Connectors – Split Bolt	ILSCO, Burndy, GB Electric
Connectors – Solderless	ILSCO, Burndy, Thomas & Betts
Connectors – Spring Wire	Ideal, 3M, Buchanan
Connectors – Compression	ILSCO, Burndy, Square D
Cable Splice Kits	RayChem, 3M, PLM
Fireproofing Tape	Scotch 3M
Surface Raceways	Mono-Systems, Thomas & Betts, Walker Systems, Wiremold
Wiring Devices – Wall Switch	Pass & Seymour, Hubbell, Bryant
Wiring Devices – Receptacle	Hubbell, Bryant, Pass & Seymour
Wiring Devices – Cover Plates	Pass & Seymour, Hubbell, Bryant, Appleton
Disconnect Switch	Square D, General Electric, Cutler Hammer
Fuses	Bussmann, Littlefuse, Gould Shawmut
Dry Transformer	Square D, General Electric, Cutler Hammer
Panel boards	Square D, General Electric, Cutler Hammer

Fluorescent, Incandescent & HID
Lamp
Fluorescent Ballasts
Fire Alarm

Osram/Sylvania, General Electric, Phillips
Advance Electronic Mark V, Valmont, Universal
Simplex Grinnell

END OF SECTION 269950

SECTION 270000 – COMMUNICATIONS GENERAL

PART 1 - GENERAL

1.1 PURPOSE

- A. Division 27 Specifications are established to define the standards, criteria, and assumptions to be used to bid, plan, furnish, install, test, and document information transport pathways and systems for Wayne State University (WSU). These Specifications shall form the basis for implementation of the design, installation, inspection, and close-out process.
- B. Division 27 is based on NFPA 70 (NEC), National Electrical Safety Code (NESC), Institute of Electronic and Electrical Engineers IEEE, ANSI/TIA/EIA Telecommunication Standards, and BICSI methodologies. The requirements within those documents are not superseded herein unless specifically stated. As required, NEC and NESC code requirements cannot be superseded by this document at any time. ANSI/TIA/EIA standards and BICSI methodologies may be superseded, as specified, or may be made stricter by this document. The absence of a specific reference to an element of these codes, standards, and methodologies does not relieve all parties of compliance with them.
- C. Within this document use of the word "shall" marks mandatory requirements. Use of the word "may" or "should" suggests optional elements. All conflicts within this document shall be resolved by the Owner's Representative (OR) in consultation with the Architect-Engineering Consultant (A-E C).
- D. Where any device or part of equipment is referred to in these specifications in the singular number (e.g. "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the Project Drawings.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00, Division 01, Division 02, and any others as published by the WSU, apply to this Section.
- B. Section 270500 – Common Work Results for Communications
- C. Section 271000 - Wayne State University, Standards for Communications Infrastructure. C&IT IT Customer Services & Telecommunications, Revised October 31, 2012.

1.3 SYSTEM DESCRIPTION

- A. Division 27 Specifications address information transport pathways, systems, spaces, media, grounding, identification, testing, and documentation requirements in support of multiple information transport infrastructures.
- B. Specific responsibilities of Division 27 include, but are not limited to:
 - 1. Identification of the interbuilding pathways, cabling, and space requirements necessary to connect the subject building(s) to the campus service facilities.
 - 2. Identification of the intrabuilding pathways, cabling, and space requirements necessary to house the data/voice/video cabling systems and associated electronic information transport equipment. Pathways and spaces shall be designed and installed to support the

- known systems and cabling requirements, as well as best effort provisions for those that may be required in the future.
3. Selection and sizing of backbone cabling media, installation, termination, testing, labeling, and documentation methods.
 4. Selection of horizontal distribution cabling media, work area requirements, and telecommunications outlet configurations, installation, termination, testing, labeling, and documentation methods.
 5. Selection of accessory items such as patch cables and custom cables.
 6. Additions to, and connection of, the communications grounding backbone furnished and installed by Division 26.
 7. Definition and establishment of administration and labeling schemes, conforming to WSU C&IT requirements.
 8. Securing all necessary permits and licenses, payment of all fees, and provision of all construction work notifications.
 9. Compliance with all applicable laws, ordinances, rules, and regulations.
 10. Mandatory Contractor Project Manager/Crew Lead attendance at a weekly project status meeting.
- C. It is the intent of the Project Drawings and Specifications to provide complete and workable Division 27 communication systems, ready for use by WSU. Any item, not specifically shown in the Project Drawings or called for in the Specifications but normally required for a fully functional system, is to be considered a part of this contract.

1.4 CODES & STANDARDS

- A. All work shall be in compliance with the following codes and agencies. Nothing contained within these Specifications shall be misconstrued to permit work not in conformance with the most stringent of applicable codes and standards. It is assumed that bidders have access to, and specific knowledge of, the listed reference materials in order to ensure conformity with them.
1. National Electrical Code (NEC)
 2. National Electrical Safety Code (NESC)
 3. National Fire Protection Association (NFPA)
 4. Federal, State, and Local Codes.
 5. National Electronic Manufacturer's Association (NEMA)
 6. Institute of Electronic and Electrical Engineers (IEEE)
 7. American National Standards Institute / Electronic Industries Association / Telecommunication Industries Association (ANSI/EIA/TIA)
 8. Occupational Safety & Health Administration (OSHA)
 9. Federal Communications Commission (FCC)
 10. American Society for Testing and Materials (ASTM)
- B. All materials, equipment, and installation practices shall meet the requirements of the following publications and standards including amendments, addenda, revisions, supplements and errata unless specifically instructed otherwise by the A-E Consultant. Publications are referenced in text by the basic designation only.
1. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard 2009, or most recent edition
 2. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard 2009, or most recent edition
 3. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard 2009, or most recent edition
 4. ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces
 5. ANSI/TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure

6. ANSI J-STD-607-A, Commercial Building Grounding and Bonding Requirements for Telecommunications
 7. ANSI/TIA/EIA-758-A, Customer Owned Outside Plant Telecommunications Infrastructure Standard
 8. ANSI/EIA/TIA-853, A Full Duplex Ethernet Specification for 1000Mb/s (1000BASE-TX) operating Over Category 6 Balanced Twisted Pair Cabling
 9. TIA-942, Telecommunications Infrastructure Standard for Data Centers
 10. TIA TSB-162, Telecommunications Cabling Guidelines for Wireless Access Points
 11. IEEE Std 1100 (IEEE Emerald Book)
 12. IEEE Project 802.3af, Remote Powering via MDI/RJ-45
 13. IEEE Project 802.3af-2005/Corr1-2006, Isolation Requirements
 14. IEEE Project 802.3an-2006, 10GBASE-T Ethernet
 15. ANSI/NECA/BICSI-568-2006 Standard for Installing Commercial Building Telecommunications Cabling
 16. OSHA CFR Standards-29, Section 1910 or most current edition.
 - a. 1910.268 Telecommunications
 - b. 1910.146 Permit-Required Confined Spaces
 17. FCC Part 68.500
 18. ASTM B1-2001 Standard Specification for Hard-Drawn Copper Wire
 19. ASTM B8-2004 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 20. IEEE 81-1983 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 21. NFPA 70-2005 National Electrical Code (NEC)
 22. UL 44-2005 Thermoset-Insulated Wires and Cables
 23. UL 65 Wired Cabinets
 24. UL 83-2003 Thermoplastic-Insulated Wires and cables
 25. UL 96 Lightning Protection Components
 26. UL 96A Installation Requirements for Lightning Protection Systems
 27. UL 467-2004 Grounding and Bonding Equipment
 28. UL 486A-486B-2003 Wire Connectors
 29. UL 497/497A/497B Protectors for Paired Conductors/Communications Circuits/Data and Fire Alarm Circuits
- C. All materials, equipment, and installation practices shall comply with accepted standards of workmanship as recognized by:
1. Building Industry Consulting Service International (BICSI)
 - a. Telecommunications Distribution Methods Manual (TDMM) 12th, or most recent, edition.
 - b. Information Transport Systems Installation Manual (ITSIMM) 4th, or most recent, edition.
 - c. Outside Plant Design Reference Manual (OSPDRM) 4th, or most recent, edition.
- D. References to industry and trade association standards and codes are minimum installation requirements.
- E. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.5 DEFINITIONS

- A. APC: Angle Physical Connector – An optical fiber connector that is polished at an angle of 8 to 10 degrees to reduce the back reflection of the signal.

- B. Attenuation: The decrease in power of a signal, light beam, or lightwave, either absolutely or as a fraction of a reference value. Attenuation is the opposite of gain and is measured in decibels (dB).
- C. Backbone System: The cabling and connecting hardware that provides interconnection between Telecommunications Rooms, Equipment Room, and Entrance Facilities.
- D. BCT: Bonding Conductor for Telecommunications – A conductor that interconnects the building's service equipment (power ground) to the telecommunications grounding system.
- E. BET: Building Entrance Terminal - Cable termination equipment used to terminate outside plant (OSP) cables at or near the point of building entry.
- F. Conduit Chase Pipe: Short section of bushed EMT conduit with sufficient size and capacity to support horizontal cabling bundles from ceiling space, through ceiling tile, onto the cable runway system connecting wall to rack or cabinet.
- G. EF: Entrance Facility – A location within a building for both public and private network service cables. A facility that provides all necessary mechanical and electrical services for the entry of telecommunications cables into a building and that complies with all relevant regulations. Also referred to as SE: Service Entrance.
- H. Engineer: A-E Consultant Mechanical or Electrical Engineer of record and Technology Systems Designer for the Project.
- I. Engineering: WSU Engineering Department.
- J. ER: Equipment Room – A centralized space designed for telecommunications equipment that serves the occupants of a building. Equipment therein is considered distinct from a TR (Telecommunications Room) because of its nature or complexity. Also frequently referred to as MDF.
- K. Facilities: WSU Facilities Maintenance Department.
- L. Fusion Splicing: An optical fiber splicing method that consists of two clean (stripped of coating) cleaved fibers then joining them and fusing the ends together with an electric arc.
- M. GE: Grounding Equalizer – A conductor that interconnects elements of the telecommunications grounding infrastructure (formerly Telecommunications Bonding Backbone Interconnecting Bonding Conductor).
- N. Horizontal System: The cabling between, and including, the TO (Telecommunications Outlet) connector and the HC (Horizontal Cross-connect) in the Telecommunications Room.
- O. HC: Horizontal Cross-Connect – A group of connectors, such as patch panel or punchdown block, that allows equipment and backbone cabling to be cross-connected with patch cords or jumpers. Floor Distributor (FD) is the international term for HC. Also frequently referred to as IDF.
- P. J-Hook: A supporting device for horizontal cables that is shaped like a “J”. It is attached to some building structures. Horizontal cables are laid in the opening formed by the “J” to provide support for cables.

- Q. LC: Lucent Connector - A small form factor (SFF) single fiber, optical fiber connector used for the termination of both multimode and single mode optical fiber cables. The housing mechanism of the LC connector (simplex and duplex) is a push-pull type connection.
- R. MC: Main Cross-Connect – The Cross-Connect normally located in the ER, or MDF for cross-connection and interconnection of entrance cables, first-level backbone cables, and equipment cables. Campus distributor is the international term for MC.
- S. Minor Pathway Support Hardware: Anchors, support brackets, clamps, clips, cable ties, D-rings, rack screws, velcro straps and etc. used to dress and secure cabling, conduits and surface raceways.
- T. Multimode Optical Fiber: Optical fiber with a core diameter of 50 or 62.5 micron (micrometer) and a cladding diameter of 125 micron; lightwave propagation allows many modes within multimode fiber. Also abbreviated as MM or FOMM.
- U. C&IT – Computing & Information Technology (WSU); having overall responsibility for the technical parameters and performance for the IT Infrastructure Upgrade Project.
- V. Optical Time Domain Reflectometer (OTDR): An instrument that measures transmission characteristics by sending a series of short light pulses down an optical fiber element/strand and provides a graphic representation of the backscattered light.
- W. Optical Loss Test Set (OLTS): A tool, consisting of a stabilized light source and optical power meter that directly measures loss by computing the difference between the optical power entering a fiber element/strand and the optical power exiting it.
- X. Police: WSU Police Service Department.
- Y. Primary Protector: A device that limits voltage between telecommunications conductors and ground (usually between 215 volt direct current [VDC] to 350 VDC). 2. A protective device placed on telecommunications conductors in accordance with codes and standards such as NFPA 70.
- Z. Radio Frequency (RF): The area (or band) of the electromagnetic spectrum where most radio communication takes place, typically from 100 KHz to 100 GHz. A frequency at which coherent electromagnetic radiation of energy is useful for communication purposes. Analog electrical signals sent on cable or over the air. Conventional (broadcast) television and radio, as well as cable TV, deliver RF signals to your television/radio.
- AA. RCDD: Registered Communications Distribution Designer – as recognized by BICSI (Building Industry Consulting Service International).
- BB. Safety: WSU Safety Office; having responsibility for the combination of safety, fire technology, and industrial hygiene.
- CC. SC: Subscriber Connector – An “full-size” optical fiber connector used for the termination of both multimode and single mode optical fiber cables (both simplex and duplex), having a square front profile with push-pull latching mechanism.
- DD. Secondary Protector: A secondary voltage protector installed in series with the indoor communications wire and cable between the primary protector and the equipment. The secondary protector provides over-current protection that will safely fuse at currents less than the current-carrying capacity of the device that it is intended to protect.

- EE. SE: Service Entrance - An entrance to a building for both public and private network service cables. A facility that provides all necessary mechanical and electrical services for the entry of telecommunications cables into a building and that complies with all relevant regulations. Also referred to as EF: Entrance Facility.
- FF. Single Mode Optical Fiber: Optical fiber with a relatively small core diameter of 8–9 micron (micrometer) and a cladding diameter of 125 micron; lightwave propagation is restricted to a single path, or mode, in single mode optical fiber. Also abbreviated as SM or FOSM.
- GG. Splice: A joining of conductors meant to be permanent. 2. A device that joins conducting or transmitting media. Also referred to as straight splice.
- HH. Splice Case: A metal or plastic housing with a semi-cylindrical cavity used to clamp around a cable splice, providing a closure.
- II. Structured Cabling: A building or campus telecommunications infrastructure that consists of a number of smaller elements (hence structured) called subsystems. For purposes of this Project, structured cabling shall be used to refer specially to the Horizontal System.
- JJ. TBB: Telecommunications Bonding Backbone - A copper conductor used to connect the Telecommunications Main Grounding Busbar (TMGB) to the Telecommunications Grounding Busbar (TGB) system.
- KK. TE: Telecommunications Enclosure - A case or housing for telecommunications cable terminations and cross-connect cabling.
- LL. TGB: Telecommunications Grounding Bus Bar - A common point of connection for telecommunications system and equipment bonding to ground, and located in the Telecommunications Room or Equipment Room.
- MM. TMGB: Telecommunications Main Grounding Bus Bar - A bus bar placed in a convenient and accessible location and bonded, by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.
- NN. TO: Telecommunications Outlet - A device placed at the user workstation for termination of horizontal media and for connectivity of network equipment. Also referred to as WAO (Work Area Outlet).
- OO. Telecommunications Room – An enclosed space designed for housing telecommunications equipment, cable terminations, and cross-connects. The room is the recognized cross-connect between the Backbone and Horizontal Systems. Also frequently referred to as IDF.
- PP. Transition Splice: A planned splice point, at the building entrance, used to transition from non-rated outdoor to indoor-rated cable designs.
- QQ. WAO: Work Area Outlet - A device placed at the user workstation for termination of horizontal media and for connectivity of network equipment. Also referred to as TO (Telecommunications Outlet).

1.6 ACRONYMS & ABBREVIATIONS

- A. WSU: Wayne State University; located at 42. W. Warren Ave., Detroit, MI 48202
- B. ACR: Attenuation-to-Crosstalk Ration

- C. ADA: Americans with Disabilities Act
- D. A-E C: Architectural-Engineering Consultant
- E. AFF: Above Finished Floor
- F. ANSI: American National Standards Institute
- G. APC: Angle Physical Connector
- H. ASTM: American Society for Testing & Materials (ASTM International)
- I. AWG: American Wire Gauge
- J. BCT: Bonding Conductor for Telecommunications
- K. BET: Building Entrance Terminal
- L. BICSI: Building Industry Consulting Service International, Inc.
- M. BTU: British Thermal Unit
- N. CATV: Community Antenna Television (Cable Television)
- O. CD: Campus Distributor
- P. dB: Decibel
- Q. dBmV: Decibel MilliVolt
- R. EF: Entrance Facility
- S. EIA: Electronic Industries Association
- T. ELFEXT: Equal Level Far-End Crosstalk
- U. EMC: Electromagnetic Compatibility
- V. EMI: Electromagnetic Interference
- W. EMT: Electrical Metallic Tubing
- X. ER: Equipment Room
- Y. FCC: Federal Communications Commission
- Z. FD: Floor Distributor
- AA. FEXT: Far-End Crosstalk
- BB. FOMM: Fiber Optic Multimode
- CC. FOSM: Fiber Optic Single Mode

DD.	FOTP: Fiber Optic Test Procedure
EE.	Freq: Frequency
FF.	GE: Grounding Equalizer (replacing TBBIBC)
GG.	Gnd: Ground
HH.	HB: Handbox
II.	HC: Horizontal Cross-Connect
JJ.	HH: Hand Hole
KK.	HVAC: Heating, Ventilation, and Air Conditioning
LL.	Hz: Hertz
MM.	IC: Intermediate Cross-Connect
NN.	IDC: Insulation Displacement Connector
OO.	IDF: Intermediate Distribution Frame
PP.	IEEE: Institute of Electrical and Electronics Engineers
QQ.	ISO: International Standards Organization
RR.	ISP: Inside Cable Plant
SS.	LAN: Local Area Network
TT.	LC: Lucent Connector
UU.	LOMMF: Laser Optimized Multimode Fiber
VV.	Mbps: Megabits per second
WW.	MC: Main Cross-Connect
XX.	MDF: Main Distribution Frame
YY.	MH: Maintenance Hole
ZZ.	MHz: Megahertz
AAA.	MM: Multimode
BBB.	NEC: National Electrical Code, NFPA 70
CCC.	NESC: National Electric Safety Code
DDD.	NFPA: National Fire Protection Association

EEE. NPI: (Corning Cable Systems) Network of Preferred Installers

FFF. NRTL: Nationally Recognized Testing Laboratory

GGG. OSHA: Occupational Safety and Health Administration

HHH. OSP: Outside Cable Plant

III. OTDR: Optical Time Domain Reflectometer

JJJ. OLTS: Optical Loss Test Set

KKK. OR: Owner's Representative

LLL. PR: Pair

MMM. RCDD: Registered Communications Distribution Designer

NNN. RFI: Radio Frequency Interference

OOO. RH: Relative Humidity

PPP. SC: Subscriber Connector

QQQ. SE: Service Entrance

RRR. SM: Single Mode

SSS. SOW: Scope of Work

TTT. TBB: Telecommunication Bonding Backbone

UUU. TBBIBC: Telecommunications Bonding Backbone Interconnecting Bonding Conductor

VVV. TC: Telecommunications Closet

WWW. TCO: Telecommunications Outlet

XXX. TGB: Telecommunications Grounding Bus Bar

YYY. TIA: Telecommunications Industry Association

ZZZ. TMGB: Telecommunications Main Grounding Bus Bar

AAAA. TO: Telecommunications Outlet

BBBB. TR: Telecommunications Room

CCCC. UL: Underwriters Laboratory

DDDD. UPS: Uninterruptible Power Supply

EEEE. WAO: Work Area Outlet

FFFF. WAP: Wireless Access Point

GGGG. UTP: Unshielded Twisted Pair

1.7 COORDINATION

- A. All Contractors shall schedule and conduct a coordination meeting with the Owner's Representative (OR) to confirm and coordinate scope of work requirements prior to commencement of work whether project is new construction, renovation, or retrofit. Project meetings shall be scheduled through the OR.

1.8 SUBMITTALS

- A. Refer to Division 01 for exact submittal procedures.
- B. Refer to each individual section for unique requirements, applicable only to that section.
- C. Approval of the OR shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- D. The Contractor shall provide for review, without exception prior to material acquisition and installation, multiple copies of the following items, in quantity as required by the OR. Specific requirements shall be listed and described within each Division 27 section. Failure to submit required items shall disqualify the Bidder.
 - 1. Information that confirms compliance with contract documents.
 - 2. Product data sheets and catalog cuts; include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets.
 - 3. Backbone/riser/cabling diagrams
 - 4. Elementary and interconnection system schematics.
 - 5. Shop drawings, pictures, nameplate data, and test reports, as required.
 - 6. Specification sheets for test equipment.
 - 7. Bill of materials.
 - 8. Contracting firm qualifications and certifications.
 - 9. Installation team qualifications by individual.
 - 10. Current manufacturer certifications.
- E. Catalog Cuts submitted for approval shall be legible and clearly identify individual items being submitted. All hardcopy and scanned electronic transmittals, whether color or monochrome, must clearly convey all markings contained on each and every copy.
- F. Submittals are required for all equipment anchors and supports to include weights, dimensions, center of gravity, standard connections, and manufacturer's recommendations.
- G. Submittals for individual systems and equipment assemblies which consist of more than one (1) item or components shall be made for the system as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- H. Approvals shall be based upon complete submission of documents together with shop drawings.

1.9 COORDINATION DRAWINGS

- A. The Contractor shall provide Coordination Drawings for review, without exception prior to material acquisition and installation for approval to proceed. Coordination Drawings shall consist of to-scale floor plans and building sections as well as conduit and duct utilization plans. Include scaled cable tray/runway layout and relationships between components and adjacent structural and mechanical elements. Show the following:
 - 1. Vertical and horizontal offsets and transitions.
 - 2. Clearances for access above and to the side of cable tray/runways, racks, and cabinets.
 - 3. Vertical elevation of cable tray/runways above floor or bottom of ceiling structure.
 - 4. Percent of anticipated fill for cable tray/basket, conduits and sleeves.

1.10 SAMPLES, REPORTS AND ADMINISTRATION DRAWINGS

- A. After approval and prior to installation, furnish the OR with material samples as listed and required within individual sections of Division 27 Specifications.
- B. Provide throughout installation:
 - 1. Material samples, if requested by the OR.
 - 2. Periodic field quality control reports.
 - 3. Periodic cable test reports.
- C. Provide prior to completion:
 - 1. Actual samples of labeling to be applied to cabling components, to be approved by the OR.
 - 2. Cable database listing patch panel station cable assignments. Database shall be provided on compact disc or other electronic media format when requested by the OR. Database shall be submitted to the requesting party within seven (7) calendar days.
 - 3. Cable administration drawings, as requested to assist WSU in the planning process. Drawings will be requested prior to final documentation and as Xerox reproductions of field copies.
- D. Provide at completion of each construction phase area, as defined by the OR:
 - 1. Cable test and certification reports; summary hard copy or full test results on compact disc when requested by the OR. Reports shall be submitted to the requesting party within seven (7) calendar days.
 - 2. One (1) set of record drawings of the actual installation of the Division 27 systems. Drawings shall be given as full size originals and on disk in AutoCAD .DWG format

1.11 OPERATING AND MAINTENANCE MANUALS

- A. Provide at final completion, four (4) hardback bound sets of O&M (Operating and Maintenance) Manuals formatted as defined by Division 01 and WSU.
 - 1. Furnish one (1) complete manual as specified in the technical section, but in no case later than prior to performance of systems or equipment test. Then furnish the remaining manuals prior to contract completion.
 - 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
 - 3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.

- B. In addition to the specific requirements contained within each Division 27 sub-section, each copy of the O&M Manual shall include, at minimum, items listed as follows:
1. One (1) copy of each approved submittal.
 2. Cable test and certification reports; summary hard copy and full test results on disc. Test results shall be delivered at the completion of each project phase and at any time when called for by the OR.
 3. Provide one (1) full-size hard copy set of record drawings (as-builts) to be submitted to the OR and A-E Consultant for approval, immediately upon completion of the installation.
 4. Instruction manuals including equipment and cable schedules, operating instructions, and manufacturer's instructions.
 5. Manufacturer Warranty Certificate.
 6. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
 7. Warranty contacts including but not limited to: names, telephone numbers (office and mobile).

1.12 QUALITY ASSURANCE

- A. Contracting firm shall be a company with a minimum of five (5) years successful installation experience with projects utilizing intrabuilding and interbuilding copper and optical fiber cabling system work similar to that required for this project.
- B. The Contractor shall provide a minimum of five (5) reference accounts at which similar work, both in scope and design, have been completed by this Contractor within the last three (3) years. Three (3) of the provided references shall relate directly to the healthcare environment. Upon request, the Contractor shall arrange a visit and consultation to referenced installations. No Contractor personnel shall be present during discussions with references. References are not required with bid but will be required of the apparent low bidder.
- C. The Contractor shall provide the experience profile of the prime contractor's project manager or job superintendent who shall be a certified RCDD responsible to manage the contract. Should the RCDD assigned to this project change during the installation, the replacement RCDD profile shall be re-submitted to the OR for review and approval.
- D. The Contractor shall be knowledgeable in WSU requirements as well as local, state, regional, and national codes and regulations. All work shall comply with the latest revision of codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall apply.
- E. Only installers trained and certified by the proposed manufacturer shall be allowed to install products. Installers must possess the highest level of certification available by the manufacturer for the specific copper cabling solution being installed.
- F. Only installers trained and certified by the proposed manufacturer shall be allowed to install firestop products.
- G. Only installers trained and certified by the proposed manufacturer shall be allowed to terminate and test optical fiber. Others specified above may pull/ place optical fiber cable under the supervision of an installer trained and certified by the manufacturer.
- H. The Contractor shall provide a narrative on the levels of registration/certification of their installers after the project is awarded but prior to commencement of work. The Contractor shall provide proof of registration/certification for the final list of installers prior to the commencement of work.

- I. The OR shall reserve the right to reject any unregistered or uncertified installers performing work for which they are not registered and certified. The Contractor shall be responsible for any loss of work, delays in schedules, or extra cost as a result of the use of unregistered/uncertified workers. Additional effort on the part of the Contractor to maintain the installation schedule as a result of the above mentioned loss time shall be the Contractor's responsibility and at the Contractor's additional expense.
- J. The Contractor shall provide to the OR the above required documentation for any worker on this project brought in after the submittal of initial documentation on installers. WSU shall periodically check installer identification and registrations/certifications during the installation.

1.13 QUALIFICATIONS

- A. The Contractor shall provide an RCDD and Installer-level BICSI Certification. A minimum percentage of fifty (50%) of the installation work force shall be BICSI Installer Level II, or possess other formal training equal to that provided by BICSI, as well as possessing a valid manufacturer certification. Up to fifty percent (50%) of installation force may be BICSI Installer Level I, or possess other formal training equal to that provided by BICSI. Work crew, not involved in installing cable elements (e.g. laborers delivering/moving materials, installing grounding by an electrician, or workers installing pathway elements) do not require BICSI or manufacturer certification or registration.
- B. The Contractor shall provide formal written evidence of the Manufacturer Certification for the system solution proposed, issued directly in the Bidder's company name, valid for the time frame in which the installation will be completed. The Contractor must be manufacturer certified for the structured cabling system approved for use with the components of this Project: Copper Horizontal System cabling by Leviton, Berk-Tek, General Cable, or Superior Essex and Optical Fiber Backbone System as a Corning Cable Systems NPI (Network of Preferred Installers) Program member and active participant.

PART 2 - PRODUCTS

2.1 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this Project, and shall have manufactured this product for at least three (3) years.
- B. Product Qualification:
 - 1. Manufacturer's product shall have been in satisfactory operation in three (3) installations of similar size and scope as this Project for approximately three (3) years.
 - 2. WSU reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to WSU within four (4) hours of receipt of notification that service is needed. Submit name and address of service organizations.

2.2 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items for which replacement parts shall be available.

- B. In addition to the requirement of SUBMITTALS, WSU reserves the right to request the manufacturer to arrange for a representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.
 - C. When more than one (1) unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
 - D. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be the products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a similar manufacturer.
 - E. Factory wiring shall be identified on the equipment being furnished and all wiring diagrams.
 - F. When factory testing is specified:
 - 1. WSU C&IT shall have the option of witnessing factory tests. The Contractor shall notify WSU C&IT through the OR a minimum of fifteen (15) working days prior to the manufacturer making the factory tests.
 - 2. Four (4) copies of certified test reports containing all test data shall be furnished to the OR prior to final inspection and not more than ninety (90) days after completion of the tests.
- 2.3 When equipment fails to meet factory test, and re-inspection is required, the Contractor shall be liable for all additional expenses, including expenses of the WSU.
- 2.4 EQUIPMENT PROTECTION
- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold, and rain:
 - 1. During installation- panels, enclosures, controllers, circuit protective devices, and other like items shall be protected against entry of foreign matter and be vacuum cleaned both inside and out before re-painting (if required), testing and operating.
 - 2. Damaged equipment shall be, as determined by the OR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
 - 3. Painted and other finished surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl; materials having all salient characteristics.
 - 4. Damaged paint or finished surfaces on materials shall be re-finished with the same quality of application or paint and workmanship as used by the manufacturer so that repaired areas are not perceptible.
- 2.5 BASIS OF DESIGN
- A. Manufacturers listed herein are preferred by WSU C&IT.
 - B. All approved manufacturers associated with WSU Standards for Communications Infrastructure are listed in the following table.
 - 1. Components listed as "Contractor Selected" are considered to be open-sourced at the discretion of the bidder.

Manufacturer	Part Number	Description	Section Reference
Erico-Caddy or B-Line		J-Hooks	WSU C&IT 17110
Carlton or Endot		Innerduct	WSU C&IT 17110
Homaco or Hubbell		Equipment Racks	WSU C&IT 17130
Homaco or Hubbell		Vertical Cable Management	WSU C&IT 17130
Homaco or Hubbell		Horizontal Cable Management	WSU C&IT 17130
Contractor Selected		Plywood Backboards	WSU C&IT 17130
Homaco, Hubbell or Cablofil		Telecommunications Cable Runway	WSU C&IT 17130
Superior-Essex, BerkTek-Ortronics, Belden, Hubbell or Commscope		Intra-Building Copper Backbone (Voice Only)	WSU C&IT 17150
Systimax, Corning, BerkTek-Ortronics or Commscope		Intra-Building Fiber Optic Backbone	WSU C&IT 17150
Commscope, BerkTek-Ortronics, Superior-Essex, Hubbell or Belden		Copper Horizontal Cabling	WSU C&IT 17150
Commscope, Ortronics, Leviton, Hubbell, Belden	UNJ600 (Commscope)	UTP Jacks and Connectors	WSU C&IT 17150
Commscope, Ortronics, Leviton, Hubbell, or Belden	UMP610-24P	UTP Patch Panels	WSU C&IT 17150
Commscope, Ortronics, Leviton, Hubbell, or Belden		Cross-Connect Blocks	WSU C&IT 17150
Commscope, Ortronics, Leviton, Hubbell, Belden		Face Plates	WSU C&IT 17150

Same manufacturer & type as the cable, jacks & patch panels installed.		UTP Patch Cords	WSU C&IT 17150
Corning Cable Systems		Fiber Optic Connectors for both Inter-Building & Intra-Building Cables	WSU C&IT 17150
Commscope, Corning, BerkTek-Ortronics		Fiber Optic Patch Panels	WSU C&IT 17150
Commscope, Corning, BerkTek-Ortronics		Fiber Optic Splice Panels	WSU C&IT 17150
Brady, Brother P-Touch, Equivalent by Tester manufacturer, Equivalent by UTP Connectivity Manufacturer		Labels	WSU C&IT 17170
Commscope	2312K	0.500 Inch Diameter Hard-Line	WSU C&IT 17500
Commscope	2227V	Coaxial Branch/Drop Cable	WSU C&IT 17500
C-Cor, Philips or Equal		Taps, Couplers, Splitters, and Equalizers	WSU C&IT 17500
Pyramid, LRC, Gilbert, Commscope or Equal		Trunk Connectors	WSU C&IT 17500
Thomas & Betts	Snap-n-Seal	Branch Cable Connectors	WSU C&IT 17500
C-Cor Flexnet NL Series or Equal		Trunk Amplifiers, Line Extenders	WSU C&IT 17500
Philips or Equal	9-LPI	Line Power Inserters	WSU C&IT 17500
Exide or Lectro "Broadband" Series or Equal		Power Supplies	WSU C&IT 17500
Grayfox Gold	7530	Coax Jacks and Wall Plates	WSU C&IT 17500
		Twelve (12) Foot, Black, 75 Ohm, Type F Coaxial Jumper Cables, Quantities per Drawings	WSU C&IT 17500

		75-Ohm Terminators for Unused Taps	WSU C&IT 17500
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EXECUTION

2.6 PROJECT CONDITIONS

- A. For work on existing stations; arrange, phase, and perform work so as to assure communications service for other buildings at all times.
- B. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior condition as required by Division 01.
- C. Remove and dispose of communications cabling, and other physical support elements, such as racks and panels, as required by construction phasing. Racks, panels, and electronic components shall be returned to the OR.
- D. Activities in all buildings are critical to the objectives of WSU. These objectives shall not be interrupted by the Contractor's work activities. The active information transport system and cabling associated with specific work beyond the construction area shall not be disrupted at any time. Unusual circumstances (e.g. voice cutovers) can occur and shall be declared and scheduled with as much notice as possible. Service disruptions, if needed, shall be at the convenience and schedule of WSU.
- E. Contractor shall ensure that all building fixtures have been re-installed to their original condition at the conclusion of the final shift of the day.

2.7 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the Projects Drawings.
- B. Inaccessible Equipment:
 - 1. Where WSU determines that the Contractor has installed equipment not "conveniently accessible" for operation and maintenance, the equipment shall be removed and re-installed as directed at no additional cost to WSU.
 - 2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit, and raceways.

2.8 WARRANTY

- A. The Contractor shall be manufacturer certified for the system proposed and bid and shall adhere to all warranty requirements for end-to-end installations.
- B. The Contractor shall submit any additional Contractor-specific warranties or guarantees to be offered on the project.
- C. The Contractor shall supply any and all necessary documentation needed to process and record the warranty(s) and to verify the installation solution.
- D. Warranty
 - 1. All installed cabling systems shall be warranted for two (2) years for components, parts, assemblies, and workmanship. During the two (2) year warranty period, Contractor shall

take all necessary and appropriate action; free of charge, to correct any non-conformity with the warranties contained in the manufacturer agreement. During the two (2) year warranty period, Contractor shall provide to WSU, free of costs and charges, all support necessary to ensure that the cabling system meets the requirements specified in this document and performance guarantees provided by the manufacturer. During the two (2) year warranty period, Contractor shall furnish, or cause to be furnished, all service, parts, and replacements necessary to maintain the cabling system in good working condition, at no cost to WSU.

2. The Contractor shall supply a full manufacturer's application assurance warranty for all new installations, to include approved termination hardware and cabling media from the proposed manufacturer's list of approved materials. Services to be provided by the manufacturer to WSU during the warranty period shall include, without limitation, the following.
3. Contractor shall provide service on WSU site as necessary including, but not limited to, fault isolation, diagnosis, and repair.
4. Records
 - a. Contractor shall maintain, at the job site, a current record of the cabling system configuration, including history and all adds, moves, and changes.
5. Replacement Parts
 - a. Contractor shall provide and install replacement parts, including new components,
6. Post-System Warranty Service
 - a. Option of Maintenance Service
 - b. Warranty of On-Site Response
 - 1) Regardless of the cause of the problem, Contractor shall ensure that parts, equipment, and materials are available to remedy the problems and its personnel are ready to begin work (such action being deemed a "response") within the contract time periods for the applicable warranty period.
7. Warranty of Security
 - a. Contractor shall warrant that its personnel, including all subcontractors, shall at all times comply with all WSU security regulations of which Contractor has been informed by WSU. Contractor also warrants that it has obtained all necessary licenses and permits required by federal, state, and local government.

2.9 FINAL CLEANING

- A. Contractor shall thoroughly clean all assemblies within all MDF, IDF and TC spaces before they are turned over to WSU for operation. Cleaning shall include, but not be limited to, all cable runway, racks and wire managers (inside and out), copper and optical fiber panels (inside and out). Should the MDF, IDF and/or TC be completed prior to the balance of the floor space that it serves, racks, cabinets, and wall frames shall be covered with plastic sheeting to repel dust and other contaminants to which they will be subjected.

2.10 WSU APPROVED LABELING FORMATS

- A. Labeling shall be furnished and applied to all components of Division 27 (WSU Division 17) according to requirements listed in Part 3 of each section. The Contractor shall make early contact with WSU C&IT (to verify any other special requirements for each project. Sample labels shall be made available upon request.

2.11 EQUIPMENT IDENTIFICATION

- A. Install an identification labels that clearly indicate information required for use and maintenance of equipment.

- B. Nameplates shall be laminated black phenolic resin with a white core engraved lettering, a minimum of 6mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by the manufacturer as a standard catalog item, or where another method of identification is specified herein, are exceptions.

2.12 TRAINING

- A. Training shall be provided in accordance with Division 01 General Requirements.
- B. Training shall be provided for the particular equipment or system as required in each associated specification section.
- C. A training schedule shall be developed and submitted by the Contractor and approved by the OR at least thirty (30) days prior to the planned training.

END OF SECTION 270000

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 00, Division 01, Division 02, and any others as published by WSU, apply to this Section.
- B. Drawings and provisions of the Contract including Division 26 Electrical.
- C. Section 270000 – Communications General
- D. Section 271000 - Wayne State University, Standards for Communications Infrastructure. C&IT IT Customer Services & Telecommunications, Revised October 31, 2012.

1.2 CODES AND STANDARDS

- A. Refer to Section 270000 – Communications General
- B. Refer to Division 01.

1.3 SUMMARY

- A. This Section includes:
 - 1. Grounding and Bonding for Communications Systems
 - 2. Hangers and Supports for Communications Systems
 - 3. Conduits and Back Boxes for Communications Systems
 - 4. Cable Runways for Communications Systems
 - 5. Surface Raceways for Communications Systems
 - 6. Vibration and Seismic Controls for Communications Systems
 - 7. Identification for Communications Systems
 - 8. Cable Routing, Separation, and Distance
 - 9. Communications Room Provisions
 - 10. Common Installation Requirements
 - 11. Firestopping
- B. All references to Division 26, contained herein, are the responsibility of the Electrical Contractor.

1.4 DEFINITIONS

- A. Refer to Section 270000 – Communications General

1.5 ACRONYMS & ABBREVIATIONS

- A. Refer to Section 270000 – Communications General

1.6 COORDINATION WITH OTHER TRADES

- A. Coordinate layout of work with other trades. Make minor adjustments in location required for coordination. Locations of structural systems, heating work and plumbing lines shall take

preference over locations of conduit lines where conflict occurs. Structural systems, heating work, and plumbing lines shall not interfere with or otherwise impede access to, and the routing of communication cabling with cable runway, raceways, or other pathways dedicated to communications. All potential issues shall be brought to the attention of the Owner immediately, before proceeding with installation.

- B. Other than minor adjustments shall be submitted to the Owner for approval before proceeding with the work.
- C. Coordinate locations, arrangement, mounting, and support of all communications provisions with Division 26.
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So that connecting raceways, cables, wireways, cable runways, and busways will be clear of obstructions and of the working and access space of other equipment.
- D. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- E. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 26.
- F. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- G. The location of TO(s) and WAO(s) shown on the Drawings is approximate, and the Owner shall have the right to relocate any TO(s) or WAO(s) before they are installed without additional cost.

1.7 SUBMITTALS

- A. Refer to Section 270000 – Communications General
- B. After approval and prior to installation, furnish the Owner with one (1) sample of each of the following:
 - 1. Surface raceway and pathway hangers, clamps and supports.
- C. Shop drawings submitted to the Owner:
 - 1. Shall include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- D. Test Reports submitted to the Owner: Shall include certified test reports of ground resistance.
- E. Certifications: Two (2) weeks prior to final inspection, submit four (4) copies of the following to the Owner:
 - 1. Certification that the grounding materials and installation is in accordance with the drawings and specifications.
 - 2. Certification, by the Contractor, that the complete grounding installation has been properly installed and tested.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN REFERENCE PART NUMBERS

- A. Bidder shall confirm all reference part numbers, listed within Division 27, as current and suitable for the items described and specified and shall file a formal RFI for all perceived discrepancies prior to bidding.
- B. Refer to Section 270000 Communications General, Part 2.

2.2 GROUNDING AND BONDING – BUILDING RISER

- A. Telecom System Grounding Riser Conductor: Telecommunications Grounding Riser shall be in accordance with J-STD-607A. Use a minimum 50mm² (3/0 AWG) insulated stranded copper grounding conductor unless indicated otherwise.
- B. Refer to Division 26 Section 260526 and specific instructions of the A-E Consultant related to conductor sizing and methods of grounding and bonding shall supersede any references within Division 27 for the building backbone.

2.3 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

2.4 SPLICES AND TERMINATION COMPONENTS

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.5 SYSTEM GROUNDING BUSBARS

- A. Refer to Division 26. Busbars shall be furnished and installed by Electrical Contractor, as specified herein. Division 27 Product Specifications for TMGB and TGB bars shall supersede any as given in Division 26.
 - 1. TMGB (Telecommunications Main Grounding Busbar) also referred to as "Master Signal Ground" shall be a pre-drilled solid copper busbar with two-hole lug connections for use with standard-sized lugs. Minimum dimensions shall be 6mm (0.25") thick by 600mm by 100mm (4" wide and 24" in length). The TMGB shall be listed by a NRTL (Nationally Recognized Testing Laboratory).
 - 2. TGB (Telecommunications Grounding Busbar) also referred to as "Room Signal Grounding" shall be a pre-drilled copper bus-bar with two-hole lug connections for use with standard-sized lugs. Minimum dimensions shall be 6mm (0.25") thick by 100mm by 300mm (4" wide and 12" in length). The TGB shall be listed by a NRTL (Nationally Recognized Testing Laboratory).

2.6 GROUND CONNECTIONS

- A. Above grade:

1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lock washers.
2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts
3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.

- B. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.

2.7 EQUIPMENT RACK AND CABINET GROUND BARS

- A. Furnish and install solid copper ground bars designed for mounting on the framework of open or cabinet- enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x 3/4 inch).

2.8 GROUND TERMINAL BLOCKS

- A. At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack- type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.9 SPLICE CASE GROUND ACCESSORIES

- A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16mm² (6 AWG) insulated ground wire with shield bonding connectors.

2.10 HANGERS AND SUPPORTS

- A. Product selection shall be subject to Part 3 installation requirements.
- B. Erico/Caddy CableCAT Wide Base Supports.
- C. Erico/Caddy Vertical Backbone Cable Support.
- D. Panduit Corporation J-Mod and J-Pro Cable Support System.

2.11 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

- A. Refer to Section 260529.

2.12 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- A. Refer to Section 260533.

2.13 CABLE RUNWAYS – COMMUNICATIONS SPACES

- A. Refer to Section 271000.

2.14 SURFACE RACEWAYS

- A. Refer to Section 260533.

2.15 SLEEVES FOR RACEWAYS AND CABLES

- A. Refer to Section 260500.

2.16 SLEEVE SEALS

- A. Refer to Section 260500.

2.17 GROUT

- A. Refer to Section 260500.

2.18 IDENTIFICATION

- A. Materials by Brady, Brother, and Panduit in compliance with ANSI/TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure

2.19 IDENTIFICATION FOR ELECTRICAL

- A. Refer to Section 260553.

2.20 PLYWOOD

- A. All walls, and area above door openings, must be covered with $\frac{3}{4}$ " Grade A-C fire-retardant plywood, sanded smooth.
- B. All plywood must contain fire-retardant stamp as per building codes and, upon installation, shall be left exposed in a minimum of one (1) unused-area of each individual sheet or separate segment of backboard, if painted.

2.21 CONDUIT CHASE PIPES

- A. Conduit Chase Pipes shall be provided within Telecom Room (TR) spaces in any case where ceiling tile has been provided and must be breached.
- B. Electrical Metallic Tubing (EMT) and Fittings
 1. 4" trade size
 - a. Manufactured to ANSI C80.3 (EMT Zinc Coated)
 - b. UL Standard 797 (EMT – Steel)
 2. Arlington insulated bushings

2.22 FIRESTOP DEVICES

- A. The approved pathway through wall penetrations, up to 8" thick, is the E-Z Path (sleeve system) by STI, or approved equal. The Contractor shall identify penetration points for horizontal cabling, but must obtain pre-approval from the Owner prior to installation.
- B. For cable basket/tray penetrations through rated walls, intumescent firestop pillows shall be installed. E-Z Path Series SSB Firestop Pillows or approved equal.
- C. For floor penetrations thicker than 8", the use of metallic conduit shall be approved. Metallic conduit sleeves shall be 4" minimum. The Owner shall pre-approve the size, quantity, and locations of the pathways. Refer to Division 26.

PART 3 - EXECUTION

3.1 FIELD CONDITIONS

- A. Examine all elements intended for Communications. Check pathways, raceways, cable runways, and other elements for compliance with space allocations, installation tolerances, installation hazards or impediments, and other conditions affecting installation. Verify that all work required in the field is adequately described in the plans. Proceed with installation only after unsatisfactory conditions and discrepancies have been brought to the attention of the Owner and corrected.
- B. Unless otherwise noted, the footages for cabling and materials shown on the Project Drawings are based upon available plant records, architectural drawings, or the A-E Consultant's route and pathway assumptions. The Contractor shall be required to perform field surveys and measurements, prior to ordering materials.

3.2 GROUNDING AND BONDING - GENERAL

- A. An approved grounding system, as specified herein, shall always be required in each communications space; ER, TR, EF, and any other information transport systems distribution space.
- B. All grounding and bonding systems for communications shall be carefully reviewed and pre-approved by the Owner in consultation with WSU Engineering and Facilities Maintenance Department in cooperation with WSU C&IT Department.
- C. All communications rack, cabinet, cable runway (within ER and TR spaces), wall frame, and equipment grounding shall be furnished and installed by the Contractor
- D. The Telecommunications Bonding Backbone (TBB) also referred to as the Communications Signal/Riser Grounding System shall have a single point of attachment at the main electrical grounding electrode conductor. The TBB, along its associated busbars and connections shall be furnished and installed by the Contractor.
- E. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
 - 3. Isolation transformers and isolated power systems shall not be system grounded.
- F. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.
- G. Route conductors on short direct paths that have minimum resistive and inductive impedance as follows:
 - a. Bonding conductors shall be routed with minimum bends or changes in direction.
 - b. Bonding connections shall be made directly to the points being bonded.
 - c. Do not bend the grounding conductor wires into tight angles. Changes in direction shall be of the widest radius possible.
 - d. Unnecessary connections or splices in bonding conductors shall be avoided. When absolutely necessary, use an approved connection and position it in an accessible location.

3.3 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.4 CORROSION INHIBITORS

- A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.5 TELECOMMUNICATIONS SYSTEM

- A. Bond telecommunications system grounding equipment to the electrical grounding electrode system.
- B. Furnish and install all wire and hardware required to properly ground, bond and connect communications raceway, cable runway, metallic cable shields, and equipment to an approved ground source.
- C. Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.
- D. Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable runway, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milliohms or less.
- E. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.
- F. Bonding Jumpers:
 - 1. Use insulated ground wire of the size and type shown on the Drawings or use a minimum of 16 mm² (6 AWG) insulated copper wire.
 - 2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
 - 3. Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.
- G. Bonding Jumper Fasteners:
 - 1. Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lock washers.
 - 2. Wireway and Cable Runway: Fasten bonding jumpers using zinc-plated bolts, external tooth lock washers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable runway to prevent cable damage.
 - 3. Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lock washers, and nuts.
 - 4. Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lock washers.

3.6 TELECOMMUNICATIONS ROOM (TR) GROUNDING

- A. Telecommunications Ground Busbars (TGB):
 - 1. Provide communications room telecommunications ground busbar hardware at 950 mm (18 inches) at locations indicated on the Drawings.
 - 2. Connect the telecommunications room ground busbars to other room grounding busbars as indicated on the Grounding Riser diagram.
- B. Telephone-Type Cable Runway Systems: aluminum pan installed on telephone-type cable runway serves as the primary ground conductor within the communications room. Make ground connections by installing the following bonding jumpers:
 - 1. Install a 16 mm² (6 AWG) bonding between the telecommunications ground busbar and the nearest access to the aluminum pan installed on the cable rack.
 - 2. Use 16 mm² (6 AWG) bonding jumpers across aluminum pan junctions.
- C. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:
 - 1. When ground bars are provided at the rear of lineup of bolted together equipment racks, bond the copper ground bars together using solid copper splice plates supplied by the ground bar manufacturer.
 - 2. Bond together nonadjacent ground bars on equipment racks and cabinets with 16 mm² (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
 - 3. Provide a 16 mm² (6 AWG) bonding jumper between the rack and/or cabinet ground busbar and the aluminum pan of an overhead cable runway or the raised floor stringer as appropriate.
- D. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near the top of backboards used for communications cross-connect systems. Connect backboard ground terminals to the aluminum pan in the telephone-type cable runway using an insulated 16 mm² (16 AWG) bonding jumper.
- E. Other Communication Room Ground Systems: Ground all metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to the cable runway pan or the telecommunications ground busbar, whichever is closer, using insulated 16 mm² (6 AWG) ground wire bonding jumpers.

3.7 STRUCTURED GROUNDING SYSTEM FOR NETWORK EQUIPMENT

- A. Structured grounding system shall provide a low resistance, verifiable, dedicated path to a locally provided TGB for purposes of maintaining performance, protection, and network reliability.
- B. All Equipment Room (ER) spaces designed to support rack mounted network equipment shall require a structured grounding system to which all communications rack, cabinet, cable runway, wall frame, and equipment grounding shall be terminated.
- C. All open frame rack assemblies and cabinets shall require vertical rack grounding strips (RGS). Strips shall be mounted on the back side of the vertical rack rails for two-post assemblies and on the back side of the front post for four-post assemblies. These mounting arrangements apply to racks based on both UTP and F/UTP cabling. Contractor shall confirm details with the Owner prior to proceeding with the installation.
- D. Furnish and install equipment including, but not limited to:
 - 1. Copper Compression HTAP(s)

2. Copper Compression Two-Hole Lugs
3. Rack-Mounted Grounding Strips(s)
4. Cabinet-mounted Front-to-Rail Jumper(s)
5. Paint-piercing Bonding Screws and Studs
6. Paint-piercing Grounding Washers
7. ESD (Electrostatic Discharge) Studs and Static Wrist Straps (one per rack or cabinet).

3.8 COMMUNICATIONS CABLE GROUNDING

- A. Bond all metallic cable sheaths in multi-pair communications cables together at each splicing and/or terminating location to provide 100 percent metallic sheath continuity throughout the communications distribution system.
 1. At terminal points, install cable shield bonding connectors provide a screw stud connection for ground wire. Use a bonding jumper to connect the cable shield connector to an appropriate ground source like the rack or cabinet ground bar.
 2. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or the splice case grounding and bonding accessories provided by the splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to an approved ground source and all other metallic components and equipment at that location.

3.9 COMMUNICATIONS CABLE BASKET AND RUNWAY SYSTEMS

- A. Bond the metallic structures of one cable runway in each runway run following the same path to provide 100 percent electrical continuity throughout these cable runway systems as follows:
 1. Splice plates provided by the cable runway manufacturer can be used for providing a ground bonding connection between cable runway sections when the resistance across a bolted connection is 10 milliohms or less. The Subcontractor shall verify this loss by testing across one splice plate connection in the presence of the Contractor.
 2. Install a 16 mm² (6 AWG) bonding jumper across each cable runway splice or junction where splice plates cannot be used.
 3. When cable runway terminations to cable rack, install 16 mm² (6 AWG) bonding jumper between cable runway and cable rack pan.

3.10 COMMUNICATIONS RACEWAY GROUNDING

- A. Conduit: Use insulated 16 mm² (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.
- B. Wireway: use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.
- C. Cable Tray Systems: Use insulated 16 mm² (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 16 meters (50 feet).

3.11 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system, as identified on Project Drawings, for compliance without additional cost to WSU. Final tests shall assure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made

before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the Owner prior to backfilling. The Contractor shall notify the Owner 24 hours before the connections are ready for inspection.

3.12 HANGERS AND SUPPORTS

- A. Communications cabling shall be contained within a combination of open spaces, enclosed conduits, raceways, and cable runways. These pathways are designed to provide the capacity to properly install high performance communications cabling for present and future applications.
- B. Where cabling is installed within conduit, cable runways, and raceways, pathways shall be furnished and installed by Division 26.
- C. Where conduit, cable runways, or raceways are not provided, Division 27 shall furnish and install independent supports so that no cable rests directly on ceiling tile, mechanical ductwork, or other supporting structures.
- D. Cables shall be neatly routed and bundled above the suspended ceiling structure in bundles limited to a quantity of cables as per manufacturer specifications and installation practices for Category 6A UTP or as applicable to the media being installed. High performance sling-type supports shall be used for adds/moves/changes or low cable c pathways. High performance J-Hook supports shall also be used.
- E. Suspended ceiling support wires shall not be used for cabling support. Cables shall not be laid directly on ceiling tiles or rails. Cables placed in hangers in the ceiling area shall be routed high and away from all other electrical and mechanical systems so as to avoid contact with light fixtures, ventilation ducts, sprinkler system or plumbing piping, motors or any other electrical devices.
- F. The maximum separation between support points for all cabling shall be five (5) feet
- G. All cable pathway support elements shall be certified by the manufacturer for a high performance twisted pair installation, when applicable. In all cases, support products shall be approved for the support of Category 6 or higher cables, including optical fiber.

3.13 HANGERS AND SUPPORTS FOR ELECTRICAL

- A. Refer to Section 260529.

3.14 CONDUITS AND BACK BOXES

- A. Refer to Section 260533.

3.15 CABLE RUNWAY – COMMUNICATIONS SPACES

- A. Refer to Section 271000.

3.16 SURFACE RACEWAYS

- A. Refer to Section 260533.

3.17 SLEEVES FOR RACEWAYS AND CABLES

- A. Refer to Section 260500.

3.18 SLEEVE SEALS

- A. Refer to Section 260500.

3.19 GROUT

- A. Refer to Section 260500.

3.20 IDENTIFICATION

- A. All cables, conductors, racks, cabinets, frame, and panels shall be labeled as per the requirements of ANSI/TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure.

3.21 COMMON INSTALLATION REQUIREMENTS

- A. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall mounting items.
- B. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- D. Right of Way: Give to piping systems installed at a required slope.
- E. The Contractor shall contact the Owner before commencement of work and shall coordinate with all Owner personnel and all other trades. Commencement of work shall be coordinated through the Owner.

3.22 CABLE ROUTING, SEPARATION, AND DISTANCE

- A. Whenever possible, primary cable routing paths shall follow the logical structure of the building. When a wall must be breached, provide sleeved openings. Cabling shall enter and exit these areas at 90° angles. Route all cables and cable raceways parallel to or perpendicular to building structure. No diagonal runs shall be permitted, unless noted otherwise.
- B. To reduce or eliminate the field effect of EMI on data signaling, cable runs shall be kept a minimum distance from EMI sources. Refer to ANSI/NECA/BICSI-568-2006 Standard for Installing Commercial Building Telecommunications Cabling.
 - 1. Minimum separation distance from possible sources of EMI:
 - a. 5 inches (125mm) from power lines of 2 KVA or less.
 - b. 12 inches (305mm) from lighting fixtures.

2. Minimum separation distance from possible sources of EMI exceeding 5KVA:

Condition	Min. Separation Distance
Unshielded power lines or electrical equipment in proximity to open or non-metal pathways.	24 in. (610 mm)
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway.	12 in. (300 mm)
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway.	6 in. (150 mm)
Electrical motors and transformers.	47 in. (1200 mm)

- C. Communications cabling shall not be run in parallel with any high voltage electrical wiring.
- D. The maximum length of horizontal communications cables shall be limited to 90 meters from the TO (Telecommunications Outlet) to the ER or TR point of termination.
- E. All cabling shall be installed as single continuous homerun pulls from Connector Block to Patch Panel, and TO to Patch Panel. No inline connectors or splices in any form shall be permitted.
- F. Cable routing from the cable runway onto the distribution frame shall be neatly organized and supported by cable support brackets, clips, loops, radius drops, spools, etc., as required to minimize tension and stress on the connector block terminations.

3.23 TELECOMMUNICATIONS ROOM (TR) PROVISIONS

A. PLYWOOD BACKBOARDS

- 1. Furnish and install for all walls, and areas above door openings, $\frac{3}{4}$ " Grade A-C fire-retardant plywood, sanded smooth.
- 2. All plywood must contain fire-retardant stamp as per building codes and, upon installation, shall be left exposed in a minimum of one (1) unused-area of each individual sheet or separate segment of backboard, if painted.
- 3. The plywood should be mounted vertically starting at 6" AFF, and secured to the walls using flush-mounted fasteners designed and listed to secure wood to the specific wall/stud material.
- 4. Mount plywood to cover entire area on which cable runway, equipment, terminating hardware, and cable management rings may be mounted.
- 5. Securely fasten plywood to wall framing members. Use flush hardware and supports to mount plywood. Ensure that the strength and placement of the hardware are sufficient to handle the total anticipated load (static and dynamic) and mounting of equipment.

B. CONDUIT CHASE PIPES

- 1. Furnish and install 4" EMT conduit "Chase Pipes" within ER, TR, EF, and other information transport system spaces where communications cabling must pass through suspended ceiling tiles enroute to point of cabling termination.
- 2. Chase Pipes shall be securely mounted to the wall above cable runway segments using slotted unistrut and 4" pipe clamps. Reamed and bush pipes at both ends prior to cabling rough-in.

3.24 FIRESTOPPING/WATERBLOCKING/INSPECTION

- A. Determination of all fire-rated structures shall be by the WSU Engineering and Facilities Management Department.
- B. All conduits, sleeves, and penetrations of fire-rated walls, into which communications cables are pulled or reserved for communications cables, shall be sealed with an approved fire-retardant method and materials in accordance with UL (Underwriter's Laboratory Inc.) Fire Resistance Directory.
- C. All openings provided shall be fire stopped after cabling has been installed whether filled, partially filled, or un-used.
- D. The Contractor shall affix a permanent "WARNING FIRE-STOP SEAL – DO NOT DISTURB" label on both sides of all fire-stop breaches. The label shall contain the following information.
 - 1. Contractor name, address, and contact information.
 - 2. Installer's name & date.
 - 3. UL listing number (Firestop product).
 - 4. F Rating.
- E. An above ceiling inspection will be required by the Owner and the Contractor after all cable has been installed and tested. Following this inspection and review of test results, all conduits, cable runways, and raceways which penetrate a firewall will be fire stopped. Conduits less than 1.5 inches in diameter are not required to be fire stopped. All conduits leaving any TR will be closed with approved products as listed in Specification 07 84 13., Materials are to be contractor furnished and installed.
- F. Water blocking materials shall be re-usable where ever possible, and shall be readily removable to allow for future reuse of conduits.
- G. After the Contractor has notified the Owner of the completion of fire stopping, an above ceiling inspection will be done for compliance with codes. The inspection will be conducted with the Owner and other state and local inspection personnel as WSU may desire. All violations will be corrected before final acceptance. It will be the responsibility of the Contractor to pay for and coordinate the inspection.

END OF SECTION 270500



Standards for Communications Infrastructure

C&IT IT Customer Services & Telecommunications
Wayne State University
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Revised: 31 October 2012

By: Pete Garabedian

This document is available online in Adobe Acrobat (.pdf) format

at

<http://computing.wayne.edu/docs/wsu-communications-standards.pdf>

Revision History

- | | |
|------------------------|--|
| 31 October 2012 | Updated to add & clarify systems requirements, specifications, clarify wording, remove redundant specifications, numbers, bullets, etc. Update URL name location & update online copy of this document in pdf format. |
| 31 October 2010 | Updated to include additional manufacturers of approved structure cabling systems, clarify wording, Add page numbers, fix table of contents page numbers, etc. Update URL for online copy of this document in .pdf format. |
| 15 June 2009 | Updated to include additional manufacturers of approved structure cabling systems. Update URL for online copy of this document in .pdf format. |
| 29 April 2005 | Updated to include exact manufacturer product names for approved Category 6e (cat6e) structured cabling system components. Add URL for online copy of this document in Adobe Acrobat (.pdf) format. |
| 1 December 2004 | First publication of completely revised document. All sections rewritten. |

Table of Contents

	Page
WSU TELECOMMUNICATIONS DESIGN GUIDELINES.....	5
SECTION 17010 - TELECOMMUNICATIONS GENERAL REQUIREMENTS.....	12
SECTION 17110 - TELECOMMUNICATIONS INTERIOR PATHWAYS.....	21
SECTION 17130 - COMMUNICATION EQUIPMENT SPACES SUPPORT HARDWARE	25
SECTION 17150 - TELECOMMUNICATIONS CABLING.....	33
SECTION 17170 - CABLE PLANT ADMINISTRATION AND TESTING	45
SECTION 17500 - C&IT CATV SPECIFICATIONS AND STANDARDS.....	49

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WSU Telecommunications Design Requirements

Applicable Standards:

Unless specifically indicated otherwise in this document, all telecommunications infrastructure shall be design in accordance with the following standards including all appropriate addendums and revisions:

ANSI/EIA/TIA-568-B	Commercial Building Telecommunications Cabling Standard
ANSI/EIA/TIA-606-A	Administration Standard for Commercial Telecommunications Infrastructure
ANSI J-STD-607-A	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
ANSI/EIA/TIA-758	Customer Owned Outside Plant telecommunications Cabling Standard
BICSI	Telecommunications Distribution Methods Manual (TDMM)
BICSI	Telecommunications Cabling Installation Manual (TCIM)

Design Deliverables:

Programming	<ul style="list-style-type: none">• With specific input from C&IT, generate outlet schedule based on functional use summary in the statement of needs/program statement.• Provide preliminary area requirements for entrance facility and telecommunication rooms• Identify extent of site work necessary to bring services to building• Where wireless networks are to be the primary connection to the network, an independent consultant with demonstrated expertise in wireless systems shall be commissioned to provide access point layout, equipment selection and input on other construction methods that may affect wireless transmissions.
Schematic Design	<ul style="list-style-type: none">• Concept Sketches showing preliminary telecommunications rooms and sizes and zone plan showing areas served by rooms.• Preliminary backbone riser diagrams showing interrelationships• Concept sketch showing major pathways for backbone and horizontal cabling

Design Development	<ul style="list-style-type: none"> • Preliminary drawings identifying device layouts for typical spaces. • Preliminary drawing showing main cable tray layouts. • Preliminary drawing showing communication backbone riser. • Preliminary drawing showing communication grounding riser.
Construction Documents	<ul style="list-style-type: none"> • Identify all device locations on scaled plan drawings • Identify outlet configurations by unique symbol and/or schedule • Identify all intended pathways and raceways for horizontal and backbone cable. • Provide enlarged telecommunications room plans indicating placement of racks, cable runway, wall mounted systems, ground bus locations. • Provide rack elevations indicating all patch panels placement, cable management, structural supports, ground connections and space allocated for owner provided network electronics and any UPS/power conditioners. • Provide backboard elevations indicating space allocated for wall fields, equipment, etc. • Indicate location and provide details for all grounding apparatus. • Provide CSI format specifications for cable, connectors, cable management hardware, etc.
Construction Administration	<ul style="list-style-type: none"> • Review shop drawings for cable, connectors, and hardware for compliance with project specifications and WSU requirements. • Make periodic construction visits to observe the installation for conformance to project specifications and proper installation practices. • Perform final punchlist including follow-up to verify punchlist items have been completed.

Systems and Performance:

Data System	<ul style="list-style-type: none"> • Designed to support 10 Gbps Ethernet to the desktop over UTP copper cable (CAT 6E) . • Inter-building backbone shall support 10Gbps Ethernet • Intra-building backbone shall support DWDM (Dense Wave Division Multiplexing)
Voice System	<ul style="list-style-type: none"> • Specific design to be coordinated with WSU C&IT.
Video Distribution	<ul style="list-style-type: none"> • Specific design to be coordinated with WSU C&IT.
Wireless Networks	<ul style="list-style-type: none"> • Specific design to be coordinated with WSU C&IT.

Site and Service Considerations:

- Incoming Services:
- Provide minimum of (4) 4" conduits from nearest telecommunications manhole, tunnel, etc. into service entrance facility. (two for WSU, one for AT&T & one for emergency maintenance spare).
 - These conduits shall be HDPE if buried underground. Steel conduit when cast in concrete. PVC conduit is not allowed.
 - Provide three 1 ¼" inner ducts in all of the service entrance conduits. In each Inner duct, a pull string must be installed.
 - The inner ducts installed must extend 6 to 8 inches past the conduit at both ends.
 - Coordinate with AT&T
 - Coordinate with C&IT for further definition of design requirements.
 - Minimum of 1 240V dedicated circuit.
 - Minimum of 1 120V dedicated circuit.
- Manholes, Handholes:
- Provide additional manholes and/or hand holes to minimize cable pulls to 400', and two 90 degree bends.
 - In Streets & Driveways, provide **5'x5'x5' concrete handhole with round steel rim and cover.**
 - In sidewalks, provide **5'x5'x5' concrete handhole with round steel rim and cover**
 - Only in Green Areas, provide 24"w x 42"d x 36"l "Quazite" hand holes. (locate hand holes in green space only)
 - Provide a # 10 gauge solid copper tracer wire in all exterior conduits for future conduit locating usage.
 - Upon completion, before final payment the following must be provided:
 - Provide a site plan of installed conduit showing conduit location, quantities & depth.
 - No exception to this will be allowed.

Grounding:

- Ground Bus
- Provide ¼" x 2" x 4' ground bus in the main telecommunications room.
 - Provide ¼" x 2" x 2' ground bus in each telecommunications room.
- Bonding Backbone
- Provide a #4/0 AWG insulated copper bonding backbone from the main ground bus in the service entrance facility (MDF) to the intermediate rooms (IDF) with #6 jumper to TGB's.
 - Do not route bonding backbone within 18" of electrical feeders.

- | | |
|--------------|---|
| Equipment | <ul style="list-style-type: none"> • Bond all racks, cabinets, etc to ground bus in each telecommunications room with #6 AWG insulated ground conductor. |
| Performance: | <ul style="list-style-type: none"> • Minimum 2 ohms |

Telecommunications Rooms (MDF, IDF):

- | | |
|------------------|---|
| Spacing Criteria | <ul style="list-style-type: none"> • Stack rooms wherever possible • Cable length shall not exceed 250'. If this is the case, additional closets will need to be built. • Provide one room for every 10 to 20,000 sft and less than 250 ft. in length of cable. • Centrally locate rooms to minimize horizontal cable lengths. |
| Security | <ul style="list-style-type: none"> • All new communication rooms will be fitted with the new WSU / Best lock key series # 88672. • All communication rooms will have WSU OneCard card electronics installed to access room via ID card swipe. • This design & layout must be coordinated with at least 1 person from WSU FP&M, WSU C&IT & WSU OneCard office. |
| Room sizes | <ul style="list-style-type: none"> • Provide minimum of one (10' x 12') MDF telecommunications room per building. • Provide one IDF telecommunications room per floor, min. (exceptions for multi-story buildings with small floor plate.) • Based on density served. • 8' x 10' for rooms serving (175) outlets or 3 racks, and 10 x 12' for rooms serving between (176) and (325) outlets, or 6 racks. • Adjust room sizes accordingly for additional systems (video, security, access control, etc.) |
| Layout | <ul style="list-style-type: none"> • Allow minimum of 24" deep for rack equipment, 36" clearance behind racks and 36" in front of racks. • Allow for 12" deep equipment on wall fields when calculating clearances. • Doors shall always swing out, provided it meets code requirements. • Provide Fire Rated ¾" grade plywood. Do not paint. • Provide 12" ladder rack around 3 sides of room & to each equipment rack. • Ladder rack shall be secured to top of equipment racks • Provide minimum 2 racks per TR |
| Lighting | <ul style="list-style-type: none"> • Locate lighting in front of and behind racks. (not above) at minimum height of 7'-6" AFF. |

- Provide 50fc minimum at floor level.
- Power
- Provide dedicated 12 circuit panel board for each MDF telecommunications room. Preferred location for dedicated panel board is telecommunications room.
 - Provide a minimum of one 20A dedicated circuit for each equipment rack plus one additional 20A circuit for service outlets, one on each wall.
 - Provide 8 plug grounded power strip at the bottom of each equipment rack.
 - Provide 8" space at the bottom of each rack for owner provided rack mounted UPS and/or power conditioner.
 - Provide dedicated feeder/riser for all telecommunications room dedicated panel boards. No other loads should be served by this feeder.
- Environmental
- Provide cooling based on 75% of total electrical room wattage.

Pathways:

- Backbone
- Provide minimum (4) 4" sleeves through floors in stacked rooms. These sleeves should be sized progressively smaller or less of them as you move away from the serving closet. Size with 30% growth after cable is installed.
 - Where rooms are not stacked, provide minimum (2) 4" conduits continuous between rooms.
 - Connect TR's on same floor with minimum of (1) 4" conduit.
 - Conduit between rooms shall have no more than (2) 90 degree bends and/or over 150' without pull box. Pull boxes shall be sized per the amount of conduits.
 - Sleeves shall consist of GRS conduit with bushings and stub above the floor a minimum of 4".
- Horizontal, accessible ceiling spaces:
- Provide cable trays down corridors whenever possible. If cost prohibitive, J-hooks are acceptable.
 - Provide J-Hooks for cable bundles of 24 and below.
 - Route main cable runs through accessible corridor spaces and drop off into each room from the main runs.
 - When ever possible do not route main cable trays or cable bundles through classrooms or offices.
 - Maintain 12" minimum between cable tray fluorescent lighting.

Backbone Cabling:

- Inter Building (between
- Minimum 96 strand single mode (glass fiber as

buildings hub)	<p>manufactured by corning) between hub buildings</p> <ul style="list-style-type: none"> • Provide 30' slack loop in manhole. • Provide 15' slack loop in telecommunications room.
Inter Building (between buildings hub to endpoint)	<ul style="list-style-type: none"> • Minimum 18 strand multi-mode and 30 strand single mode (glass fiber as manufactured by corning) between hub and endpoint buildings. • Provide 15' slack loop in each telecommunications room. • Single, composite cable is preferred.
Intra Building	<ul style="list-style-type: none"> • Minimum 12 mmf/12 smf. • 15' slack at each end.

Horizontal Cabling:

Data:	<ul style="list-style-type: none"> • Category "6E" UTP cable. (refer to section 10.4 C) • Terminate on patch panel on rack. • Cable shall be Green and jacks shall be orange located in the outlet bottom position (vertical) or the outlet right position (horizontal). • Provide cable and connectors only from WSU preferred manufacturers list. (refer to section 10.4 C) • Provide 2 gray patch cords per data outlet.
Voice:	<ul style="list-style-type: none"> • Category 6E UTP cable. (Refer to section 10.4 C) • Terminate on wall mounted 110 blocks • Cable shall be Yellow and jacks shall be White located in the outlet top position (vertical) or the outlet left position (horizontal). • Provide cable and connectors only from WSU preferred manufacturers list. (refer to section 10.4 C) • If terminated on wall fields, design adequate slack loops in closets to move from wall fields to racks in future.
Security Cameras	<ul style="list-style-type: none"> • Category "6E" UTP cable. (refer to section 10.4 C) • Terminate on wireless patch panel on rack, not data patch panel. • Cable shall be purple and jacks shall be orange located in the outlet bottom position (vertical) or the outlet right position (horizontal). • Provide cable and connectors only from WSU preferred manufacturers list. (refer to section 10.4 C) • Provide 2 purple patch cords per data outlet.
Wireless Access Points	<ul style="list-style-type: none"> • Category "6E" UTP cable. (refer to section 10.4 C) • Terminate on wireless patch panel on rack, not data patch panel.

- Cable installed in the walls shall be Purple and jacks shall be orange located in the outlet bottom position (vertical) or the outlet right position (horizontal).
- Provide cable and connectors only from WSU preferred manufacturers list. (refer to section 10.4 C)
- Provide 2 green patch cords per data outlet.

OneCard System Installation:

General

- All OneCard design, hardware, software & installations must be coordinated & approved by Business & Auxiliary Operations – IT Business Operations Department & Computing & Information Technology – Network Services Department.
- OneCard equipment will be located in its own enclosure(s), in C&IT communication rooms whenever possible.
- OneCard equipment is never to be collocated in enclosures with any other equipment.
- OneCard equipment will require its own dedicated 120volt 20 amp circuit.
- No exception to any of these bullets will be allowed.

Workstation Outlets:

General

- Unless noted otherwise, a typical outlet shall consist of (1) data and (1) voice.
- Every enclosed space shall be provided with a minimum of (1) data and (1) voice.
- The data cable shall be Green and jacks shall be orange located in the outlet bottom position (vertical) or the outlet right position (horizontal).
- The voice cable shall be Yellow and jacks shall be White located in the outlet top position (vertical) or the outlet left position (horizontal).

Classrooms

- (1) D, (1) V at teaching wall
- Wall phone near door.

Offices

- (1) D, (1) V at desk location. (Typical corner opposite door unless furniture layout or program statement indicates otherwise.)

Conference Rooms &

- (1) D, (1) V, (1) Video minimum in the room.

Conference Room Tables	<ul style="list-style-type: none"> • A conference room table of 10 seats or less, provide (1) 2" sleeve through the floor to the table for multi media connectivity. • A conference room table of 10 seats or more, provide (2) 2" sleeves through the floor to the table for multi media connectivity.
Public Spaces	<ul style="list-style-type: none"> • Provide a data drop for each vending, copier, ATM machine or any other network device.
Labs	<ul style="list-style-type: none"> • Use specific user requirements or outfit as a typical classroom.
Furniture Coordination	<ul style="list-style-type: none"> • (1) V, (1) D per cubicle. Coordinate raceways with furniture specifier. Outlets must be mounted to furniture. Double stick for mounting is not acceptable. Outlets lying on the floor are not acceptable. • Voice/Data jacks mounted on the wall may route voice/data patch cords directly through systems furniture, or they can be wired permanently with a cable whip from the wall, ceiling or floor to the systems furniture. This installation must comply with NEC code specifying low voltage & high voltage cables must be separated by a divider channel. It is the responsibility of the communications cabling contractor to meet this standard and install correctly. • WSU / C&IT / IT Customer Services / Telecommunication cabling vendors & or technicians will not fish any wire or patch cord through systems furniture raceway. They will NOT cut any holes, remove knock outs, provide or install jacks & face plates in the systems furniture.

Administration (Labeling):

Number Scheme:	<ul style="list-style-type: none"> • [Room Number] – [jack number + function]. Ex: 222-V01, 222-D01, 222-V02, 222-D02, 223-V01, 223-D01, etc.
Voice / Data Jacks	<ul style="list-style-type: none"> • [Room Number] – [jack number + function]. Ex: 222-V01, 222-D01, 222-V02, 222-D02, 223-V01, 223-D01, etc.
Security Cameras	<ul style="list-style-type: none"> • CAM-[room number] terminated in access point patch panels. If outside use WSU building number.
Wireless Access Points	<ul style="list-style-type: none"> • WAP-[room number] terminated in its own group of patch panels. If in corridor use closest room number.
Room Numbers	<ul style="list-style-type: none"> • Use final room numbers that have been approved by WSU facilities as actual room numbers. DO NOT use room numbers that appear on construction documents that are temporary/pending room numbers.

Inter Backbone & Endpoint Fiber Cables between buildings

- For backbone cables, [cable type]-[WSU Building Number]. Example: BC-193 = hub to hub inter-building backbone cable for building 193. EC-062 = hub to endpoint inter-building backbone cable for building 062. RC-193 = inter-building redundant backbone cable for building 193. RC-062= inter building redundant backbone cable for building 062.

Intra Building Fiber Riser Cables Between Communication Rooms

- For building riser cables between communication rooms, [cable type]-[WSU Building Number]-[floor number]-[communication room number]. Example: BRC-027.03.315

Testing and Documentation:

Testing Criteria:

- Comply with EIA/TIA testing requirements
- To be done by the cabling installation contractor. They must be certified to install the product line chosen. No exception to this will be allowed.
- Comply with manufacturer testing requirements.
- Testing shall demonstrate compliance with all parameters of manufacturer's stated performance.

Documentation:

- Upon completion, before final payment the following must be provided.
- Provide the manufacture warranty certificate upon completion.
- Provide (1) electronic copy of test results in PDF file format.
- No Exception to this will be allowed

Frequently Asked Questions:

(future use)

SECTION 17010 - TELECOMMUNICATIONS GENERAL **REQUIREMENTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and supplementary conditions including division 1 specifications apply to work in this section.

1.2 SUMMARY

- A. This Section includes telecommunications general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.3 DRAWINGS

- A. The Drawings must show the location of equipment racks & elevations, Ladder rack on 3 walls, power outlet locations, general arrangement of equipment, electrical systems and related items. The installation will follow as closely as elements of the construction will permit.
- B. The Drawings must show a conduit & cabling riser diagram from MDF & related IDFs. Copper pair & fiber strand counts will be detailed showing the distribution of riser cabling between the MDF & related IDFs.
- C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer and WSU C&IT.
- D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect and WSU C&IT for resolution.

1.4 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the work must be conducted before submitting proposal.

- B. The submitting of a proposal implies that the Contractor has visited the site and understands the conditions under which the work must be conducted.

1.5 CONTRACT BREAKDOWN

- A. WSU Facilities Department retains the installation and coordination for all projects initiated by that department.. WSU C&IT retains the design review, installation and coordination for all other voice, data & video projects not initiated by WSU Facilities.
- B. Within two (2) weeks following award of contract, submit to the Architect/Engineer for approval a contract amount breakdown. Breakdown shall be submitted on a form similar to the form available at the Architect's/Engineer's office. All requests for payment shall be based on the approved breakdown.

1.6 TEMPORARY FACILITIES

- A. Provide and remove upon completion of the project, in accordance with the general conditions, a complete temporary telephone service during construction, as required.

1.7 ALTERNATES

- A. See Alternate Section and other applicable parts of the Specifications.

1.8 GUARANTEE

- A. Contractor guarantees that the installation is free from defects and agrees to replace or repair, any part of this installation which becomes defective within a period of one year following final acceptance, provided that such failure is due to defects in the equipment, material or installation or to follow the Specifications and Drawings. File with the Owner any and all guarantees from the equipment manufacturers and warranty certificates.

1.9 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for telecommunications work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules and regulations.
- B. Rules of local service providers shall be complied with. Check with the local exchange carrier supplying service to the installation and determine all raceways and devices required including, but not limited to, all terminal cabinets, backboards, space requirements, etc.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed Drawings or diagrams which may

be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction in excess of code requirements, the Drawings and/or Specifications shall govern.

1.10 STANDARDS OF MATERIAL AND WORKMANSHIP

- A. All materials shall be new, never used, reused, reconditioned, or refurbished components. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

A.N.S.I.	American National Standards Institute
A.S.T.M.	American Society for Testing Materials
BICSI	Building Industry Consulting Services International
I.C.E.A.	Insulated Cable Engineer's Association
I.E.E.E.	Institute of Electrical and Electronics Engineers
N.E.C.	National Electrical Code
N.E.M.A.	National Electrical Manufacturer's Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries

Association

U.L.	Underwriters Laboratories, Inc.
NFPA	National Fire Protection Agency

- B. Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved.
- C. All equipment of the same or similar systems shall be by the same manufacturer.

1.11 RECORD DRAWINGS

- A. Provide complete operating and maintenance instruction manuals covering all telecommunications equipment herein specified, together with parts lists. All literature shall be furnished in triplicate for Owner and shall be bound in book or ring binder form as directed by Architect/Engineer.
- B. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:
1. Routine maintenance procedures.
 2. Trouble-shooting procedures.
 3. Contractor's telephone numbers for warranty repair service.
 4. Shop Drawings.
 5. Recommended spare parts lists.
 6. Names and telephone numbers of major material suppliers.
- C. Provide revised telecommunications working Drawings indicating "as-built" conditions. Drawings shall indicate all changes that have occurred during construction. Properly and identify backbone and horizontal wiring pathways.

Locate all network and workstation devices. Identify all devices on plan with proper labeling. Identify outside plant backbone conduits, man holes & fiber cables installed on a site plan. "as-Built" Drawings shall be submitted on AutoCAD 2000 or newer electronic DWG file format. Provide (1) copy paper and (1) copy electronic DWG file.

- D. Provide a site plan with elevations showing any man holes, hand holes or conduit installed outside.

1.12 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of telecommunications equipment and shall be of the manufacturer's latest design.
- B. No substitutions will be allowed without WSU C&IT approval.

1.13 SHOP DRAWINGS/SUBMITTALS

- A. All shop drawings shall be submitted in groupings of similar and/or related items (cable and connectors, equipment cabinets and racks, etc.). Incomplete submittal groupings will be returned unchecked.
- B. Provide detailed layout shop drawings (on transparent media) of backbone and horizontal cabling distribution, pathways, equipment room layouts, details and related information necessary of installation and maintenance. After review by the Engineer and WSU C&IT, a copy of Drawings will be stamped and returned to the Contractor.
- C. Submit for approval eight (2) copies of shop drawings for all telecommunications systems or equipment but not limited to the items listed below. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation. Refer to other sections of the Specifications for additional requirements.
 - 1. Structured cabling system components
 - 2. Structured cable system raceways and supports
 - 3. Outside plant cabling and components
 - 4. Outside plant ducts manholes, hand holes & conduit systems on a site plan with elevations.
 - 5. Equipment racks and cabinets including management components
 - 6. Labeling equipment
 - 7. Telecommunications grounding components
 - 8. Conduit, inner duct, junction and pullboxes
 - 9. Surface raceway components
 - 10. Manholes, hand holes and all accessories

11. Telephone system components
12. Data network system components
13. Audio/video system components
14. Access control system components
15. Security Camera system components

1.14 USE OF EQUIPMENT

- A. The use of any equipment or any part thereof for purposes other than testing even with the Owner's consent shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.

1.15 WORK SPECIFIED UNDER OTHER DIVISIONS

- A. The following items are an integral part of the telecommunications system and will be provided by the Electrical Contractor & or Telecommunications Contractor.
 1. Raceways
 2. Boxes, cabinets and enclosures.
 3. Grounding and Bonding
 4. Underground Utilities

1.16 CONTRACTOR QUALIFICATIONS

- A. The Installing Contractor for each communications system shall have a minimum of 5 years of experience with the types of systems specified. They must be certified to install, test & warranty the product specified prior to a bid submittal. **No exception to this will be allowed.**
- B. The Installing Contractor shall submit a reference list consisting of a minimum of [3] [5] installations of equivalent size and complexity of this contract. The reference list shall contain the following information for each installation:
 1. Name of project, square footage, location and brief description of systems.
 2. Date of completed installation.
 3. Contact name and phone number of facility representative.
 4. Total bid amount of each system installed.
 5. Final contract amount of each system installed, including all change orders and bulletins.
- C. The Installing Contractor shall submit with the bid the names and registration numbers of members of the firm that have a valid membership and are certified with BICSI as Registered Communications Distribution Designers (RCDD). This Contractor shall identify at least one RCDD assigned to this project in the bid.

- D. The bidding, shop drawing submittal, procurement of materials, the installation as-builts and record documents shall be reviewed and overseen by the RCDD(s) assigned to the project.
- E. The Contractor's bid, shop drawing submittals, as-builts and record documents shall bear the valid seal of the RCDD(s) assigned to this project.
- F. The Installing Contractor of the video system shall submit with the bid names and license numbers of all members of the firm that hold a valid commercial general class license with the FCC. The Contractor shall identify at least one FCC licensed technician/engineer assigned to this project with the bid.
- G. All calculations, shop drawings, testing, certification and as-built documents shall be directly supervised by the licensed technician/engineer assigned to the project.
- H. The contractor must provide a copy of the manufacturer's certification that the contractor is currently certified to install, test & warranty the proposed system prior to a bid submittal. See Section 17110, 7.5A & section 17010, 1.16A. No exception to this will be allowed.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 INSTALLATION OF EQUIPMENT

- A. Install all equipment in strict accordance with all installation specifications set by the equipment manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer and WSU C&IT for resolution.

3.2 WORK PERFORMED BY OTHERS

- A. [Electrical Contractor shall install 4" sq. sheet steel wall boxes, minimum 1" trade size conduit (or as indicated on drawings) stubbed 12" above ceiling with 6" radius (or as required by TIA/EIA-569), with a 90 degree bend at top in the direction towards route destination, and plastic bushing for recessed locations.]
- B. [Electrical Contractor shall install 4" sq. cast boxes. Minimum 1" trade size conduit (or as indicated on Drawings) stubbed up to 10' AFF (or as indicated on Drawings), with 6" radius (or as required by TIA/EIA-569) for surface mounted locations.]
- C. [The Owner will provide access point & network electronics equipment in all Communications Rooms as required.]

- D. The Owner will provide all voice & data cross-connect jumpers.

3.3 DEMOLITION WORK

- A. All demolition of existing telecommunications Cable, equipment and materials shall be specified by C&IT and done by this Contractor unless otherwise indicated. Include all items such as, but not limited to, cable, patch panels, devices, and wiring called out on the Drawings and as necessary whether such items are actually indicated on the Drawings or not in order to meet NFPA requirements.
- B. In general, demolition of old low voltage communications cabling work is indicated on the drawings, however, the contractor shall visit the job site to determine the full extent and character of this work. All existing voice & data jacks demolished need to be documented. A room number, Jack number (if still there), approximate location in the room & the communication room where it terminated need to be identified. This information must be returned to C&IT IT Customer Services Telecommunications department.
- C. None of the recovered material shall be reused in the new work.
- D. Where equipment or fixtures are removed, outlets shall be properly blanked off, and conduits capped. After alterations are done, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present systems to be modified shall not be changed unless required by the specific revisions to the system as specified or as indicated.
- E. Reroute cable as required to maintain service. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining outlet boxes or at the panels.
- F. Where new walls and/or floors are installed which interfere with existing telecommunications outlets, devices, etc., this Contractor shall adjust, extend and reconnect such items as required to maintain continuity of same.
- G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface metal raceway or exposed conduits will be permitted only where approved by the Architect/Engineer and as specifically indicated on the Drawings.

3.4 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings via a Project Coordinator. However, this Contractor, once work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.

- B. Adequately protect and preserve all existing and newly installed work. Promptly repair any damage to same at this Contractor's expense.
- C. Consult with the Owner's Project Coordinator and C&IT Project Coordinator as to the methods of carrying on the work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all telecommunications services shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's representative.

3.5 COORDINATION

- A. Install work to avoid interference with work of other trades including, but not limited to, architectural, mechanical and electrical trades. Remove and relocate any work that causes interference at this Contractor's expense. Disputes regarding the cause of interference will be resolved by the Owner's representative or Architect/Engineer.
- B. If there is a general contractor, The general contractor is responsible for the construction schedule. All work activities are to be coordinated with the general contractor.

3.6 CHASES AND RECESSES

- A. Chases and recesses shall be provided by the Architectural Trades, but this Contractor shall be responsible for coordinating their accurate location and size.

3.7 SLEEVES

- A. Provide and install Hilti Speed Sleeve model CP-630 or EZ path fire stop system wherever conduits or cabling pass through fire rated walls, floors or cables pass through openings in walls.
- B. Sleeves are used in standard walls & floors with no fire rating. All sleeves through the floor are to extend 4 inches above floor, unless otherwise noted. Provide escutcheons at each sleeve in finished areas and adequate spacing between sleeves to accommodate escutcheons.

3.8 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

- A. Refer to General Conditions for requirements.
- B. All cutting, patching and repair work shall be done by the Contractor.

3.9 EXCAVATION AND BACKFILLING

- A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the telecommunications work. Coordinate the work with other excavating and backfilling in the same area.
- B. Refer to electrical Drawings and the architectural Specifications for excavating and backfilling methods and materials.

3.10 ACCESS DOORS

- A. Provide access doors for installation by architectural trades. In the walls, provide Milcor No. "DW" or "M" as required to make all controls, electrical boxes and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. In the ceiling, provide Milcor No. 3210, 3105 or 3206 for accessibility as mentioned above, 24 inches x 24 inches minimum size. The plaster or acoustical tile insert shall be by the architectural trades. Areas with accessible ceilings (ceilings where tiles are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors.
- B. When access doors are in fire resistant wall or ceilings, they must bear the Underwriters Laboratories, Inc., Label, with time design rating equal to or exceeding that of the wall or ceiling unless they were a part of the tested assembly.

3.11 CLEANING

- A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
- B. Final cleanup shall include, but not be limited to, cleaning all telecommunications equipment spaces, devices, cover plates, and removing all scrap cable and debris from pathways.

3.12 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be protected from theft, injury or damage.
- B. Protect conduit openings with temporary plugs or caps.
- C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's Project Coordinator or Architect. Equipment set in place in unprotected areas must be provided with temporary protection.

3.13 EXTRA WORK

- A. For any extra telecommunications work that may be proposed, this Contractor shall furnish to the General Contractor, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. This Contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done.

3.14 DRAWINGS AND MEASUREMENTS

- A. These Specifications and accompanying Drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either shall be as binding as if call for by both. The Contractor will understand that the work herein described shall be complete in every detail.
- B. The Drawings are not intended to be scaled for rough-in measurements or to serve as shop drawings. Field measurements, necessary for ordering materials and fitting the installation to the building construction and arrangement, shall be taken by this contractor.

3.15 Automation System Program Code

- A. All automation system uncompiled and compiled program codes, source codes, custom modules, graphical user interface screen shots and any other automation system programming data and material (Program Code) shall be provided to the UNIVERSITY in hard copy and on CD Rom in an unencrypted format acceptable to the UNIVERSITY.
- B. Copyright for the Program Code shall be assigned to the UNIVERSITY for purposes of system maintenance.
- C. Provision of and Copyright assignment of the Program Code to the UNIVERSITY by the Vendor shall be conditions of the Purchase Order and contract acceptance by the Vendor.
- D. Provision of and Copyright assignment of the Program Code to the UNIVERSITY by the Vendor shall be conditions of final System acceptance by the UNIVERSITY.

END OF SECTION 17010

SECTION 17110 - TELECOMMUNICATIONS INTERIOR **PATHWAYS**

PART 4 - GENERAL

4.1 RELATED DOCUMENTS

- A. Related Sections include the following:
 - 1. Division 17 Section "Telecommunications General Requirements."

4.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NFPA-297 - Guide on Principles and Practices for Communication Systems.
- C. ANSI/TIA/EIA 568-A - Commercial Building Telecommunications Cabling Standard.
- D. ANSI/TIA/EIA 569-A - Commercial Building Standard for Telecommunications Pathways and Spaces.
- E. ANSI/TIA/EIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications.
- F. ANSI/IEEE-110-1992 - Powering and Grounding Sensitive Electronic Equipment.
- G. BICSI – Building Industry Consulting Services International.

4.3 SUBMITTALS

- A. Submit all structured cabling system raceways and supports identified in this section under provisions of Section 17010.
- B. Product Data: Provide for products specified and required.
- C. Shop Drawings: Indicate project specific part numbers, dimensions, support points, fittings and finishes.

4.4 PROJECT RECORD DOCUMENTS

- A. Submit all structured cabling system raceways and supports identified in this section under provisions of Section 17010.

- B. Accurately record equipment layout and cable layouts in all telecommunication spaces.

4.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 17010.
- B. Protect products from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

4.6 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduits, and cable pathways prior to rough-in.

4.7 DESCRIPTION OF SYSTEMS

- A. Communications cabling systems pathways shall be installed in accordance with ANSI/TIA/EIA 569-A.
- B. Intra-building backbone cabling shall be installed in conduit, cable tray or J-hook support system.
- C. Horizontal cabling (cabling from the telecommunications room to the work area outlet) pathways shall consist of [conduit] [cable tray] [J-hooks] [under floor duct system] [raised access flooring system] [accessible ceiling space] [cellular flooring system] as indicated on Drawings and as required.
- D. Where the accessible ceiling systems [raised access flooring systems] are used as the primary pathway, cabling shall be installed [in main cable tray runs] as indicated on the Drawings, with individual work area cables routed exposed [in conduit] and supported as specified herein.

PART 5 - PRODUCTS

5.1 J-HOOKS

- A. Manufacturers:
 - 1. Erico-Caddy.
 - 2. B-Line.
- B. Horizontal cable routed exposed through ceiling space shall be supported from J-hooks.

- C. J-hooks shall be a minimum of 5/8" wide and shall have a bearing surface that complies with required bend radii of the specified cables to be supported.
- D. J-hooks shall have flared or folded edges to prevent damage when installing cables.

5.2 INNERDUCT

- A. Manufacturers:
 - 1. Carlon.
 - 2. Endot.
- B. Install inner duct through conduits and sleeves for optical fiber cabling installations.
- C. Description: UL listed, non-metallic, corrugated flexible conduit for use in plenum or riser installations as applicable. Provide each inner duct with one 1/4" W pull tape with a tensile rating of 900 lbs.

PART 6 - EXECUTION

6.1 GENERAL

- A. Where cables pass through fire rated walls, the Contractor shall provide and install Hilti Speed Sleeve model CP-630 or EZ path fire stop system. This penetration sleeve must match the fire rating of the wall. The penetration shall be sized per ANSI/TIA/EIA-569.
- B. Any other wall or floor penetrations that aren't fire rated, the Contractor shall fire-stop the penetrations, after final cable installation, using Engineer-approved materials. Fire-stopping materials shall be installed per manufacturer's recommendations and shall maintain partition rating and integrity. All fireproofing shall be applied in a neat manner with all excess material cleaned from all walls and surfaces. Contractor shall replace and re-install all fireproofing materials removed during cable installation.
- C. Contractor shall patch and repair any holes or other damage to walls or partitions and paint to match original, as applicable.
- D. The Communication Cabling Contractor shall provide plastic and/or grounding bushings, as applicable, on all conduit sleeves, stubs and conduit terminations that may have been missed by the Electrical Contractor.
- E. All cutting, patching and restoration to the original condition of walls, ceilings, floors, etc., shall be the responsibility of the Contractor.
- F. All ceiling removal and restoration required for the execution of this work shall be the responsibility of the Contractor.

- G. Any additional existing voice & data jacks demolished need to be documented. A room number, Jack number (if still there), approximate location in the room & the communication room where it terminated need to be identified. This information must be returned to C&IT IT Customer Services Telecommunications department.
- H. All cabling installed exposed in accessible ceiling systems shall be supported by cable tray or J-hooks.
- I. All J-hooks shall be supported directly from the structure above or wall mounted, as applicable, independent of ceiling framing, electrical conduit, mechanical piping and ductwork. Provide all-thread rod with ¼" diameter or equivalent supporting means with suitable fasteners when attaching to structure or structural members. Increase size of support as required when multiple J-hooks (stacked or tree configuration) are attached to single support based on maximum loading capacity of J-hooks.
- J. J-Hooks shall be spaced 48" Minimum or 60" maximum on center.
- K. Telecommunications cabling shall be routed in continuous conduit above hard ceilings or between floors in any kind of offset condition.
- L. Communications cable pathway routing shall be coordinated with above ceiling work of other Contractors to avoid conflicts and potential sources of EMI.
- M. Do not route exposed communications pathway within 12" of lighting fixtures and electrical power feeders.
- N. Route inner duct for all fiber optic backbone cabling, in cable tray, conduit, and sleeves. Coordinate routings and quantities with Drawings.

END OF SECTION 17110

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SECTION 17130 - COMMUNICATION EQUIPMENT SPACES SUPPORT
HARDWARE

PART 7 - GENERAL

7.1 RELATED DOCUMENTS

- A. Related Sections include the following:
 - 1. Division 17010 Section "Telecommunications General Requirements."

7.2 SECTION INCLUDES

- A. Equipment racks.
- B. Equipment cabinets.
- C. Equipment shelves.
- D. Cable management.
- E. Backboards.
- F. Telecommunications cable runway.

7.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NFPA-75 - Protection of Electronic Computer Data Processing Equipment.
- C. NFPA-297 - Guide on Principles and Practices for communication Systems.
- D. ANSI/TIA/EIA 568-B.1,2,3 - Commercial Building Telecommunications Cabling Standard.
- E. ANSI/TIA/EIA 569-A - Commercial Building Standard for Telecommunications Pathways and Spaces.
- F. ANSI/TIA/EIA 607-A - Commercial Building Grounding and Bonding Requirements for Telecommunications.
- G. ANSI/IEEE-110-1992 - Powering and Grounding Sensitive Electronic Equipment.
- H. BICSI – Building Industry Consulting Services International.

7.4 SUBMITTALS

- A. Submit under provisions of Section 17010.
- B. Product Data: Provide for racks and all cable management hardware
- C. Shop Drawings: Indicate dimensions, support points, and finishes.
- D. Submit layout Drawings to scale of all communication rooms indicating routing of all cable runway, elevations of equipment racks indicating all equipment to be installed, and all wall penetrations.

7.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 17010.
- B. Accurately record equipment layout and cable layouts in all telecommunication spaces.

7.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 17010.
- B. Protect products from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

7.7 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduits, and cable pathways prior to rough-in.

PART 8 - PRODUCTS

8.1 EQUIPMENT RACKS

- A. Manufacturers:
 - 1. Homaco.
 - 2. Hubbell.
- B. Description: Nominal 19" x 84"H equipment rack, with universal EIA hole spacing for mounting equipment and accessories.
- C. Material: 6061-T6 heavy-duty aluminum or equivalent.

- D. Provide all hardware for floor mounting and anchoring.
- E. Provide one (1) equipment shelf and all mounting hardware.
- F. Provide complete ground bar kit with all required hardware
- G. Provide power plug strip mounted to equipment rack, with a minimum of 6 surge-protected outlets and 10-foot cord.

8.2 WALL MOUNTED EQUIPMENT RACKS

- A. Manufacturers:
 - 1. Homaco.
 - 2. Hubbell.
 - 3. Blackbox.
- B. Description: Wall mounted rack, nominal 19" x 48"H, or 19" x 84"H, as indicated on Drawings.
- C. Material: Equivalent construction as floor mounted rack, with steel hinge and mounting hardware.
- D. Finish: Telco black powder coat.
- E. Width: Nominal 22 inches.
- F. Depth: Nominal 28 inches projection from wall.
- G. Height: Nominal 48 inches.
- H. Provide complete ground bar kit with all required hardware.
- I. Provide power plug strip with a minimum of 6 surge-protected outlets in cabinet and 10 foot cord.

8.3 VERTICAL CABLE MANAGEMENT

- A. Manufacturers:
 - 1. Same as equipment rack.
- B. Description
 - 1. Duct style cable management panel for mounting on equipment racks with slotted construction to allow multiple cable exits, [double sided for front and rear management] and fluted to allow cables to pass from front to rear.
 - 2. Removable solid cover.
 - 3. Material: ASTM A569 steel or 5052-H32 aluminum.

4. Provide (2) 3"W cable management units between racks and one 6"W at ends. Cable management unit shall be [84"H] [96"H] by nominal 6"D
 5. Finish: Electrostatic powder coat, post-fab painted in black.
- C. Provide all hardware required for securely mounting panel to equipment rack.

8.4 HORIZONTAL CABLE MANAGEMENT

- A. Manufacturers:
1. Same as equipment [rack] [cabinet].
 2. Same as UTP connector.
- B. Description
- C. Cable management bar with split D-rings [with pass-through holes] [removable cover] for mounting on 19" rails.
- D. Material: [Steel] [High-strength plastic].
- E. Dimensions: Provide one (1) rack unit and two (2) rack unit sizes to coordinate with size of corresponding patch panel. D-rings shall be nominally 5"D.

8.5 EQUIPMENT CABINETS

- A. Manufacturers:
1. Hubbell.
 2. Great Lakes Cabinets.
- B. Standard equipment cabinet, floor mounted, will be nominal 24"W x 30"D x 84"H, fully welded steel construction, lockable front and rear doors (roof fans) cable management, 19" EIA mounting racks and adjustable, fixed shelves as required.
- C. The cabinet frame shall be constructed of four cold rolled steel components – top, bottom, left and right welded to form a self supporting framework. The side members shall be fabricated from 16 gauge cold rolled steel. The top and bottom shall be fabricated from 14 gauge cold rolled steel. The vertical uprights shall have integral cable management channels with provisions for hook and loop or traditional cable ties. The frame shall be designed to be bolted side by side to other frames.
- D. The side covers shall be constructed of 19 gauge cold rolled steel with double bent flanges along the entire perimeter. The side covers shall lift off easily via grip handles assembled to the covers. The side cover shall have clusters of rectangular perforation to accommodate ventilation for equipment providing greater than 100 sq. in. of ventilation.
- E. The front door shall be a window door assembled to the frame via spring-loaded hinges at the top and bottom. The door shall be locking with a unique operator's

key. The operator's key shall operate the front door only. The latch shall be flush to the door. The window shall be a .125" acrylic panel secured to a reinforced steel frame.

- F. The rear door shall be a steel door assembled to the frame via spring-loaded hinges at the top and bottom. The door shall be locking with a unique service personnel key. The service personnel key shall operate both the rear and front doors. The latch shall be push button operated. The rear door shall be reinforced and have a cluster of rectangular perforations for ventilation.
- G. The top shall have a removable panel in the center, designed to be replaced with a cooling fan, and six 3" diameter cable entry knockouts; three along each side to route cables directly into vertical cable organizers minimizing the number of bends to the cables.
- H. The bottom panel shall be similarly configured with 6 knockout locations. The cabinet bottom shall also be provided with holes for securing the cabinet to the floor.
- I. The top cover shall accept the mounting of a 250 CFM cooling fan.
- J. The cabinet shall be pre-configured for 19" mounting with universal hole spacing per the EIA 310 standard requirements.
- K. The cabinet shall feature three sets of rails, front, center, and rear. The front set of rails shall be 20 rack positions high, from the bottom of the cabinet. The rear and center rails shall be the full internal height. The recess of all three sets of rails shall be adjustable forward and back. The rails shall be tapped for a #10-32 screw. The center rails shall be formed in a 'C' profile, 3" deep, tapped on both the front and rear flanges so as to provide the functionality of an open frame rack. The front and rear rails shall be of an L shape.
- L. The entire enclosure shall be finished with a durable polyurethane powder coat – medium texture, and shall be **black** in color.

8.6 EXTRA LARGE EQUIPMENT CABINETS

- A. Description: Extra large equipment cabinets, floor mounted, nominal 30"W x 36"D x 84"H, fully welded steel construction, lockable front and rear doors, roof fans, cable management, 19" or 23" EIA mounting racks as indicated and required, and adjustable, fixed shelves as required.
- B.

8.7 WALL MOUNTED EQUIPMENT CABINETS

- A. Manufacturers:
 - 1. Hubbell.

2. Great Lakes Cabinets.

- B. Equipment cabinet, wall mounted will be nominal 24"W x 48"H x 24"D, with equivalent construction as standard floor mounted cabinet except with double hinged center section.
- C. The cabinet body shall consist of 16 gauge cold rolled steel formed and welded construction. The cabinet body sides shall have clusters of rectangular perforations to accommodate adequate ventilation for the enclosed equipment. The top and bottom of the cabinet body shall also have a circular cut with a removable cover plate for the mounting of an optional 250 cfm cooling fan. The cabinet shall be symmetrical in design to allow front and rear doors to open left or right.
- D. The rear door shall consist of 16 gauge cold rolled steel formed and welded construction with a double bent flange along the door's entire perimeter. There shall be two (2) pairs of wall mounting holes located at the upper and lower surface of the door, spaced 16" on center for mounting to studded wall construction. The top and bottom edge of the rear door shall each have three (3) through hole cut outs [3" in diameter] with removable plastic covers, along with two (2) double ring knock out holes for 1.12" or 0.88" through-hole openings. The rear door shall be symmetrical in design to allow for reverse mounting. The door shall be locking with a unique key to operate the rear door only.
- E. The front door shall be made of 16 gauge cold rolled steel formed and welded construction, with a double bent flange along the entire perimeter. The door should be available in both solid and a framed window. The window version shall have .125" thick acrylic panel secured to a reinforced steel frame. The door shall be locking with a unique operator's key, which operates the front door only.
- F. The wall mount cabinet shall be pre-configured for 19" mounting with #12-24 tapped holes 5/8", 5/8", 1/2" EIA standard hole pattern. The 19" mounting rails shall be constructed of 11 gauge cold rolled steel. Mounting rails shall also be fully adjustable from front to back of the cabinet.
- G. The entire cabinet shall be finished with a durable polyurethane powder coat, medium texture, and be available in black or office white.
- H. The wall mount cabinet shall be designed so that access to all internal components can be from the front or rear of the cabinet body by way of a dual hinge design.
- I. Weight: Load capacity of the cabinet shall be 150 lbs. Dedicated 120V cabinet installed in cabinet.
- J. Provide dedicated 120V circuit installed in cabinet.

8.8 BACKBOARDS

- A. Description: AC-grade fire rated or better plywood backboard in sheets measuring 4'W x 8'H x 3/4"D. Plywood sheets shall be free of all voids. Plywood shall have a minimum of two coats of fire-resistant, non-conducting paint applied to all sides of all sheets. Provide flush hardware and supports to mount plywood to wall. The provided hardware shall have sufficient strength to carry all anticipated loads including, but not limited to cabling, cable management, equipment and terminating hardware and electronics equipment.

8.9 TELECOMMUNICATIONS CABLE RUNWAY

- A. Manufacturers:
 - 1. Homaco.
 - 2. Hubbell.
 - 3. Cablofil.
- B. Description: 16 gauge tubular steel stringer style, with rungs 9"-12" O.C.
- C. Material: 3/8" x 1-1/2" tubular steel with 1/2" x 1" steel channel rungs, or equivalent.
- D. Finish: Telco gray [black] powder coat.
- E. Width: 18 inches, or as indicated on Drawings.
- F. Provide manufacturer's standard hardware and accessories indicated and required to provide a complete system. Provide minimum 3/8" diameter threaded rod and mounting hardware for cable runway. Cable runway must be mounted from the sides. It is not permissible to support the cable runway from the center. No exception to this will be allowed.
- G. Provide 6" H side mount vertical retaining posts on each side at minimum 48" intervals to maintain cabling on runway, or vertical members integrally attached to rungs. Provide same finish color as runway.
- H. Provide cable drop-off, radius fittings as required for cable transitions from horizontal to vertical. Provide same finish color as runway.

PART 9 - EXECUTION

9.1 EQUIPMENT RACKS

- A. Contractor shall furnish and install wall mounted and floor-mounted equipment racks per manufacturer's recommendation.
- B. Provide equipment racks of same type, style and finish color as existing, where applicable.

- C. The racks shall be labeled according to the Drawings and in accordance with specification 17170 "Cable Plant Administration and Testing."
- D. Free standing equipment racks shall be bolted to the floor using anchors in concrete floor and toggle bolts through raised flooring.
- E. All racks, cabinets and cable transport hardware shall be bonded to the communications system ground riser.
- F. Mount the top of the equipment racks to the bottom of cable runway unless noted otherwise on Drawings for the cable runway to be higher.
- G. Dedicated power circuits for each equipment rack will be located at the bottom or the top of the equipment racks as indicated on the drawings.
- H. Each equipment rack will have separate ground wire to the ground buss bar.

9.2 EQUIPMENT CABINETS

A. Free Standing Cabinets

- 1. Cabinets shall be installed in a location that allows both the front and rear door to open a full 90 degrees.
- 2. Cabinets employing cooling fans shall be installed such that there is at least 6" of clear space above the top of the fan casing.
- 3. Each free standing equipment cabinet will have a separate ground wire to the ground buss bar.

B. Wall Mount Cabinets

- 1. Wall mount cabinets shall arrive on site fully assembled and ready to install.
- 2. When mounting the cabinets to studded wall construction, the cabinet must be secured to the wall studs to assure adequate support for the enclosure and its contents.
- 3. Cabinets shall be installed in such a way as to not interfere with the use of the front door or hinged body section.
- 4. Each wall mount cabinet will have a separate ground wire to the ground buss bar.

9.3 EQUIPMENT SHELVES

- A. Install per manufacturer's recommendations using all hardware required.

9.4 CABLE MANAGEMENT

- A. Install vertical and horizontal cable management panels per manufacturer's recommendations.

- B. Install vertical panels on each side of free-standing equipment racks.
- C. Install horizontal patch panels of equivalent quantity as patch panels and of equivalent size, i.e. one rms of cable management panels for one rms of patch panels.

9.5 BACKBOARDS

- A. A minimum of three walls (or as indicated on Drawings) shall be covered with plywood backboards to a minimum 8'-6" above finished floor in all Telecommunications spaces and as indicated on Drawings. Normally no plywood is needed on the wall where the door is.
- B. Securely fasten backboard to wall using appropriate hardware and mount at all four corners, minimum. Securely fasten backboard to wall-framing members (studs).
- C. Provide adequate backboard space to allow a clean and workable arrangement for telephone and data connections. Keep all non-voice data item to corners of shortest wall (doorwall).

9.6 TELECOMMUNICATIONS CABLE RUNWAY

- A. Provide tubular steel cable runway in communications closets around 3 sides of the room for proper cable management. Provide all mounting hardware to securely mount to equipment racks, wall, ceiling or structure above, as required. Provide supports recommended by manufacturers and no more than 10 ft O.C.
- B. As a minimum, mount runway at each end to wall using appropriate hardware. Where overall length is greater than 10 ft, provide supplemental support from structure above or from equipment racks and cabinets below. Provide additional supports as required to prevent runway from swaying.
- C. Mount runway directly to top of racks unless noted otherwise on drawings for the cable runway to be higher.
- D. Runway shall run around 3 sides of perimeter of room and an additional 4th section across the center of the room securing the top of the equipment racks to the cable runway. Normally no cable runway will be needed on the door side wall unless cable sleeves / cable tray entering the communication room are over the door header or noted otherwise on the drawings.
- E. Each section of the cable runway section will be grounded and bonded together.
- F. The cable runway will have a separate ground wire to the ground buss bar.

END OF SECTION 17130

SECTION 17150 - TELECOMMUNICATIONS CABLING

PART 10 - GENERAL

10.1 RELATED DOCUMENTS

- A. Related Sections include the following:
 - 1. Division 17010 Section "Telecommunications General Requirements."
 - 2. Telecommunications construction drawings.

10.2 REFERENCES

- A. ANSI/TIA/EIA-568-B.1,2,3 - Commercial Building Telecommunications Cabling Standard.
- B. ANSI/NFPA 70 - National Electrical Code.
- C. FCC Part 68 - Connection of Terminal Equipment to the Telephone Network.
- D. FCC Part 15 - Radiation Limits.
- E. FCC Part 76 - Cable Television Service.
- F. BICSI TDMM - Telecommunications Distribution Methods Manual, Latest Edition.
- G. BICSI TCIM - Telecommunications Cabling Installation Manual, Latest Edition.

10.3 PROJECT CONDITIONS

- A. Verify field measurements are as shown on Drawings.
- B. Verify suitability of all pathways prior to cable installation.

10.4 CABLING SYSTEM PERFORMANCE

- A. General:
 - 1. Cabling system performance shall meet or exceed current industry standards and/or manufacturers' specifications as specified herein.
 - 2. The cable installed in the walls, connectors, jack, patch panels, & patch cords must be the same manufacture & model that forms the

complete cabling system channel. The total system shall meet the performance criteria described below.

3. The cable and connector devices shall be certified compatible by the manufacturer of each component to meet the performance criteria described below. Submit manufacturer's certification with submittals.
4. The referenced standards describing the performance below shall include all revisions, clarifications and bulletins to the original standard referenced as well as any standards cross-referenced.
5. The referenced standards describing the performance below shall apply to backbone cable, horizontal cabling and connecting hardware performance requirements as well as installation standards and techniques and field testing and verification of performance.

B. A plenum category 5E (CAT5E) cabling in a 25 pair cable bundle is to be utilized for voice (telephone) building backbone riser only. Category 5E performance is defined by TIA/EIA 568-B for 100 ohm UTP cables and associated connecting hardware whose transmission characteristics are specified up to 16 MHz.

C. Category 6 enhanced (CAT6E) cabling shall be utilized for all voice, data, wireless access points & security camera horizontal wiring. For WSU projects, any one of the following five cat6e structured cabling system products are acceptable:

1. Hubbell NEXTSPEED Cat 6 enhanced
2. Superior-Essex/Leviton NextGain Cat6EX
3. BerkTek-Ortronics Lanmark-2000
4. Beldon DataTwist 600e
5. CommScope Uniprise 7504 Cat6E

Category 6e performance is defined by the manufacturers of the above cabling products,

D. Fiber optic cabling shall be utilized for all data building backbone riser. Fiber optic performance is defined as follows:

1. Multimode:
 - a. **[62.5]**/125µm core/cladding fiber optic cable. The cable shall be dual rated for 850nm and 1300nm and meet all performance requirements of TIA/EIA 568-B at each transmission wavelength.
 - b. Maximum attenuation: 3.5dB/km @ 850nm
 - c. 1.0dB/km @ 1300nm
 - d. Bandwidth: 160MHz*km @ 850nm
 - e. 500 MHz*km @ 1300nm
2. Singlemode:
 - a. Provide nominal 9/125µm core/cladding, singlemode dispersion unshifted fiber optic cable. The cable shall be rated for 1310nm and

- 1510nm and meet all performance requirements of TIA/EIA 568-B at each transmission wavelength.
- b. Maximum Attenuation: 0.5dB/km @ 1310nm
- c. 0.5dB/km @ 1550nm
- d. Bandwidth: 2GHz*km @ 1310nm
- e. 2GH*/km @ 1550nm

10.5 CONTRACTOR QUALIFICATIONS

- A. The installing Contractor shall be certified by the cabling and connector manufacturer of the structured cabling system product selected from 1.4.C (above). A letter of certification from the manufacturer shall be included in the bid submittal. No exception to this will be allowed.

10.6 SUBMITTALS

- A. Product Data Sheets:
 - 1. Submittals shall be complete and bound in 3-ring binders (or similar fashion) for Engineer's approval prior to ordering equipment.
 - 2. The binders shall contain manufacturer's product data sheets for the specific items to be installed for this project.
 - 3. Contractor shall highlight or otherwise identify each specific item to be installed, by catalog number, on each product data sheet. The Contractor shall indicate specific color, style, configuration, etc., and all accessories specified and required for a complete installation.
- B. Samples (May Be Required)
 - 1. Submit samples of all cabling to be provided in this section for Engineer's review prior to installation. Samples shall be 12" in length and shall be labeled.
 - 2. Submit 2 sets of samples of all types of cable labels to be provided in this section. Attach one set to the cable samples, and submit together for Engineer's review.
 - 3. Submit sample of labeling scheme proposed for the project. Include all labeling scenarios such as cables, outlets, patch panels, racks, etc. Submit proposed schemes for Engineer/Owner review prior to installation.

10.7 UNIT PRICING

- A. Provide separate unit pricing included with bid for each of the following:
 - 1. A complete workstation drop of each type of outlet indicated (e.g. A, B, C, etc.) of length 100 feet, including all cabling, connectors, faceplate, labeling, installation, termination and testing.

2. Complete schedule C of WSU's purchasing bid package.

10.8 UTP CABLING SYSTEM WARRANTY

A. General

1. The UTP voice and data cabling system shall be warranted by the manufacturer(s) of the components for a period of not less than 20 years from the time the installation is deemed complete.
2. It shall be the sole responsibility of the low voltage cabling Contractor to register the project with the manufacturer(s) and meet all manufacturers' warranty requirements.
3. It shall be the sole responsibility of the low voltage cabling Contractor shall provide Owner with test results, all manufacturers' warranty certificates with Record Documents including a site plan elevation with outside plant man holes, hand holes & conduit.

B. Warranty Coverage

1. Product - all passive components of the cabling system shall be warranted to be free from defects in material and workmanship.
2. Performance - all passive components, as installed, shall meet or exceed all published performance data.
3. This will exceed TIA and ISO performance specifications for Permanent Link and Channel, as required, at all frequencies specified.
4. Applications - the installed Permanent Link and Channel shall be warranted to support all current applications, as well as those introduced in the future, that require the specified cabling system per TIA, ISO & cabling manufacture specifications.

C. Warranty Requirements

1. Provide a Permanent Link warranty for all voice drops. Provide a Channel warranty for all data drops.
2. Warranty shall cover repair or replacement of all defective components free of charge, including all labor performed by a manufacturer-certified installer. All new or replacement components shall be furnished new. Never used, reused, reconditioned, or refurbished components shall be allowed.
3. The installing Contractor shall be certified by the cabling and connector manufacturers as an approved and trained installer of their equipment. Submit letter of certification from the manufacturer to the engineer at time of submittal. No exception to this will be allowed.

PART 11 - PRODUCTS

11.1 INTER-BUILDING FIBER OPTIC BACKBONE

A. Singlemode fiber optic cabling

1. Manufacturers:
 - a. Systimax
 - b. Corning
 - c. BerkTek-Ortronics
 - d. CommScope
2. Description: Nominal 9/125 μm , [6] [12] [18] [24] [36] [48] [96] strand or as indicated on Drawings, loose tube, all-dielectric cable, rated for outdoor use. Cable shall have water-blocking properties to prevent water penetration and fiber damage. Cable shall have maximum 12 stands per tube, and an overall Polyethylene jacket.
3. Description: Nominal 9/125 μm , [6] [12] [18] [24] [36] [48] [96] strand or as indicated on Drawings, loose tube, armored cable, rated for outdoor use. Cable shall have water-blocking properties to prevent water penetration and fiber damage. Cable shall have maximum 12 stands per tube, and an overall Polyethylene jacket.
4. Description: Nominal 9/125 μm , [6] [12] [18] [24] [36] [48] [96] strand or as indicated on Drawings, loose tube, OFNR rated for indoor/outdoor use. Cable shall have water-blocking properties to prevent water penetration and fiber damage. Cable shall have maximum 12 stands per tube, and an overall UV resistant, flame retardant jacket.

11.2 INTRA-BUILDING COPPER BACKBONE (VOICE ONLY)

A. Manufacturers:

1. Superior-Essex
2. BerkTek-Ortronics
3. Beldon
4. Hubbell
5. CommScope

B. Description:

1. Twisted pair copper conductors, 24 AWG, solid annealed copper. Provide [25] [50] [100] pair cable bundles, as indicated on Drawings.

2. Cable rated Category 5 voice backbone cable, UL Listed CMR, CMP as required.
3. 25 pair binder groups color coded per industry standards.
4. Flame-retardant PVC insulation for riser rated applications, low-smoke PVC insulation for plenum applications, color-coded for each conductor per industry standards.
5. White, flame-retardant PVC outer jacket for riser rated applications, gray low-smoke PVC outer jacket for plenum applications.

11.3 INTRA-BUILDING FIBER OPTIC BACKBONE

A. Multimode fiber optic cabling

1. Manufacturers:
 - a. Systimax
 - b. Corning
 - c. BerkTek-Ortronics
 - d. CommScope
2. Description: [62.5]/125 μm , [6] [12] [18] [24] [36] [48] strand or as indicated on Drawings, tight buffered, OFNP. Cable shall be comprised of individually jacketed, and uniquely identified fibers with an overall orange sheath.
3. Horizontal & Vertical fiber cable shall be furnished with performance requirements for the system served (voice, video or data) as indicated on the drawings riser diagram.

B. Singlemode fiber optic cabling

1. Manufacturers:
 - a. Systimax
 - b. Corning
 - c. BerkTek-Ortronics
 - d. CommScope
2. Description: Nominal 9/125 μm , [6] [12] [18] [24] [36] [48] strand or as indicated on Drawings, tight buffered, OFNP. Cable shall be comprised of individually jacketed, and uniquely identified fibers with an overall yellow sheath.
3. Horizontal & Vertical fiber cable shall be furnished with performance requirements for the system served (voice, video or data) as indicated on the drawings riser diagram.

11.4 COPPER HORIZONTAL CABLING

A. Manufacturers:

1. CommScope
2. BerkTek-Ortronics
3. Superior-Essex
4. Hubbell
5. Beldon

B. Description:

1. Horizontal cable shall be furnished with performance requirements for the system served (voice, video or data) as indicated on the drawings riser diagram.
2. Category 6 enhanced: 23 AWG, 4-pair, 100 ohm, UTP, [CMR] [CMP], with green jacket for data & wireless access points, yellow jacket for voice cabling, purple jacket for security camera cabling. See exact products in section 10.4 C above.
3. Voice jacks will terminate on wall mount 110 type termination blocks. Workstation, server, printer etc. data jacks will terminate in their own group of patch panels installed in equipment racks. Wireless access point & security camera data jacks will terminate in their own separate group of patch panels installed in the equipment racks.

11.5 UTP JACKS AND CONNECTORS

A. Manufacturers:

1. CommScope UNJ600.
2. Ortronics
3. Leviton
4. Hubbell
5. Beldon

B. Modular jacks for UTP cables:

1. 8 position, 8 conductor, non-keyed, universal modular jack, snap-in type, terminated with a 110 style pc board connector, color coded for T568A & T568B wiring.
2. Designed to terminate 22-26 AWG solid on insulation-displacement 110-style connectors.
3. Contacts shall be minimum 50 micron gold-plated in the contact area.
4. Rated to match the performance of the cabling system they are installed on.
5. Color coded for system served as indicated on the Drawings.
6. Furnish keystones (icons) for jack identification. Keystones for voice jacks shall be **[White]** and keystones for data, wireless access points & security cameras jacks shall be **[orange]**.

11.6 UTP PATCH PANELS

A. Manufacturers:

1. CommScope UMP610-24P or UMP610-48P.
2. Ortronics
3. Leviton
4. Hubbell
5. Beldon

B. UTP Patch Panel:

1. Patch panel shall serve as data jack, security camera and wireless access point system horizontal cross connect.
2. Wireless access point & security camera data jacks will be terminated on their own patch panel separate from the workstation data jack patch panels.
3. Patch panel shall be configured for standard 19" rack mounting.
4. High density type with 24 modular jack ports for every standard rack mount unit (1.75" high).
5. Maximum 6 port groupings of replaceable modules.
6. Terminations for the "building side" cabling on 110-style insulation pc board connectors color-coded for T568B terminations.
7. Horizontal and vertical cable management hardware front and rear.
8. Performance shall meet the performance of the cabling system they are installed on.
9. Constructed of black anodized aluminum with adequate structural integrity so that panel will not deflect when center of panel is pushed with the hand.
10. Provisions for icons and labeling to comply with the labeling requirements in specification 17170, "Cable Plant Administration and Testing".

11.7 CROSS-CONNECT BLOCKS

A. Manufacturers:

1. CommScope.
2. Ortronics
3. Leviton
4. Hubbell
5. Beldon

B. Cross-connect blocks

1. Cross connect blocks shall be used for voice connectivity [backbone to] horizontal cross connects:

2. Wall mount 110 type wiring blocks mounted in a modular frame design that includes the frame, blocks, vertical and horizontal wiring troughs, and designation strips.
3. Provide wire management frames between adjacent vertical sections to allow management of cross connect wiring.
4. The frames and horizontal wiring troughs shall be constructed of steel (painted white or ivory in color), the wiring blocks, connecting blocks and vertical frames shall be constructed of molded polycarbonate.
5. Blocks shall be marked black every fifth pair.
6. Locate backbone frames on the right and horizontal frames on the left.

11.8 FACE PLATES

- A. Manufacturers: Same as jacks and connectors, unless otherwise noted. In almost all cases in labs, stainless steel plates will be called out in lieu of plastic. Reference construction drawings.
- B. Face plates for wall mounted workstation outlets shall allow a minimum 2 and maximum of 6 positions and accept snap-in jacks, as specified.
- C. Face plates for recessed outlet boxes shall be high-strength nylon, [white] color, single-or double-gang as required and as applicable. Face plates shall be equipped with label slots, top and bottom, and clear polycarbonate covers for each label.
- D. Provide duplex mounting frames, as required, to mate and match jacks to face plates.
- E. Provide stainless steel faceplates with attachment hooks for hanging telephone device for outlets indicated as wall phone outlets.

11.9 UTP PATCH CORDS

- A. Manufacturers:
 1. Shall be the same manufacturer & type as the cable, jacks & patch panels installed in the building..
- B. Description:
 1. Provide two (2) patch cords, one of each length specified, for each data port in patch panel outlet and one (1) patch cord for each data port for the workstation, length as specified above.
 2. For the communication room side provide 24 AWG, 4-pair, 100 Ohm, solid, UTP patch cords of similar construction, impedance-matched, having compatible performance as copper UTP horizontal and fully warranted, as required.

3. For the workstation room side provide cords with stranded conductors and jacketing for greater flexibility, having compatible performance as copper UTP horizontal and fully warranted, as required.
4. Patch cords shall be **[10'-15']** in length, gray color for the workstation, **[3'-7']** in length, gray color for the communication room, **[1']** in length, green color for the access point & **[3']** in length, purple color for the security cameras. Coordinate possible different lengths with Owner.

11.10 FIBER OPTIC CONNECTORS FOR BOTH INTER – BUILDING & INTRA – BUILDING CABLES

A. Manufacturers:

1. Corning Cable Systems.

B. Multimode fiber optic connectors shall be:

1. Field installed **[SC]** type in 12/24 port panels for INTRA – BUILDING riser tie cabling between communication rooms. Provide **[black]** color connector.
2. Field installed **[SC]** type in 12/24 port panels for INTER – BUILDING tie cabling between buildings. Provide **[blue]** color connector.

C. Singlemode fiber optic connectors shall be:

1. Field installed **[SC]** type in 12/24 port panels for INTRA – BUILDING riser tie cabling between communication rooms. Provide **[black]** color connector.
2. Field installed **[SC]** type in 12/24 port panels for INTER – BUILDING tie cabling between buildings. Provide **[black]** color connector.

D. Singlemode fiber optic connectors for video shall be:

1. Field installed **[SC/APC]** type in 12/24 port panels for INTRA – BUILDING riser tie cabling between communication rooms. Provide **[green]** color connector.
2. Field installed **[SC]** type in 12/24 port panels for INTER – BUILDING tie cabling between buildings. Provide **[green]** color connector.
3. Connectors shall be epoxy polish **[SC/APC]** type with ceramic ferrule with tool kit.
4. Connectors shall be fusion type. Compression type connectors shall not be allowed.
5. All **[SC/APC]** connectors and ferrules shall be green in color.
6. Field Install A Minimum of 2 strands or Coordinated exact quantities and requirements for **[SC/APC]** terminated fiber optic strands with C&IT-IT Customer Services- Telecommunications department prior to installation.

11.11 FIBER OPTIC PATCH PANELS

A. Manufacturers

1. CommScope.
2. Corning
3. BerkTek-Ortronics

B. Description:

1. Rack-mounted, minimum 24-port patch panel with modules or panels as indicated suitable for mounting connector types as specified and as required, complete with slide-out fiber management tray and management rings and clips to maintain minimum bend radius of fibers, and lockable front and rear doors, clear, tinted-polycarbonate front door (03U and 04U panels only).
2. Provisions for icons and labeling to comply with the labeling requirements in specification 17170, "Cable Plant Administration and Testing".

11.12 COPPER SPLICING PRODUCTS

A. Manufacturers:

1. 3M – Series 2-Type FR 510 Closure.

B. Description: Copper splice case, indoor, re-openable, sized for pair counts indicated on Drawings. Provide all hardware and accessories required to make the quantity and type of splices as indicated on the Drawings.

11.13 FIBER OPTIC SPLICE PANELS

A. Manufacturers:

1. CommScope.
2. Corning
3. BerkTek-Ortronics

B. Description: Rack-mounted splice enclosure with splice trays, cable strain relief hardware, sliding shelf, locking front and rear doors, grommated entry points, and open-side design for easy fiber egress.

C. Splice trays shall be for heat-shrink fusion splices and compatible with splice panel.

PART 12 - EXECUTION

12.1 GENERAL

- A. In addition to the notes contained on the Drawings, the following Contractor notes shall apply.

12.2 CABLE ROUTING

- A. Route all cables and cable raceways parallel to or perpendicular to building structure.
- B. All cables shall be installed as single continuous "home-run" pulls from connector block to connector block, or from patch panel in the telecommunications room to voice/data workstation outlet in the work area.
- C. Cable that is run above a suspended ceiling should be supported per manufacturer's recommendations, whether in approved cable tray, in conduit, or by j-hooks.
- D. All data/communication cables, not installed in conduits, shall be supported by j-hooks supported from the bar joists or trusses. No tie-raps or bundling allowed.
- E. The number of voice/data cables per hanger shall not exceed manufacture rating.
- F. The maximum spacing of cable hangers and supports shall be 60 inches or less. Level changes may require additional support. Contractor shall be responsible to replace all fire-proofing materials displaced during installation of hangers to maintain required fire rating of structure.
- G. Communication cable and infrastructure shall be independently supported.
- H. Do not support or tie-wrap any cables to ductwork, plumbing lines, fire suppression, electrical conduits, mechanical systems, or ceiling system.
- I. Do not directly lay or route voice/data cables on ductwork, piping and plumbing systems or on top of the lay-in ceiling tile.
- J. Minimum clearance distance requirements shall be observed:
 - 1. 5" (125 mm) from power lines of 2 KVA or less.
 - 2. 12" (305 mm) from high voltage lighting (including fluorescent).
 - 3. 39" (1 m) from power lines of 5 KVA or greater.
 - 4. 39" (1 m) from transformers and motors.
- K. All cable must be free of tension at both ends as well as over the length of the run.

- L. Only Velcro straps are permitted as cable bundle supports. Waterfalls from cable tray shall not pinch, bind, crimp or in anyway deform or cause physical damage to the cable jacket, or alter the electrical characteristics of the voice/data cables.
- M. Contractor shall take care to assure that during and upon completion of the installation, all cables are free of kinks, sharp bends, twists, gouges, cuts or any other physical damage which may cause physical or electrical characteristic alterations to the cables. The cables must also be installed at the proper room temperature. Any of these conditions will constitute a replacement of the installed cable.
- N. Contractor to observe all minimum bend radius and tension limitations, etc., as specified by the cable manufacturer when installing the cables.
- O. Contractor shall supply neatly bundled slack loops of length 10 feet for all cabling in telecommunications spaces. Provide neatly bundled slack loop 1 foot above the ceiling at workstation end.
- P. Provide Velcro cable ties periodically in all runs and within the telecommunications spaces provide slack loops per standards and to neatly bundle cables.
- Q. Route all optical fiber cabling in inner duct. Support inner duct with j-hooks a maximum five feet on center when not routed in conduit or cable tray.

12.3 CABLE TERMINATIONS

- A. The Contractor who installs the communications cabling shall terminate & test the finished link. It is not allowed to have a non certified electrical contractor install the communications cable & have another certified contractor terminate, test & warranty it. No exceptions to this will be allowed. Terminate all wiring at both ends using the T568B convention. All voice and data cables shall be terminated in accordance with ANSI/TIA/EIA 568-B installation guidelines.
- B. Contractor to install all modular jack dust covers and 110 style module "stuffer" caps as per manufacturer's recommendations on all workstation outlets and patch panels.
- C. All voice (phone) cables shall terminate in the designated telecommunications room to standard 110 type punch down blocks. The punch blocks shall be mounted to the plywood backboard.
- D. All data cables shall be terminated on rack mounted, high density, patch panels.
- E. Wireless access point & security camera data jacks will be terminated on their own patch panel separate from the workstation data jack patch panels.
- F. All cable terminations shall be free of stress or tension when complete.
- G. Provide sufficient slack and manage cabling accordingly.

12.4 OUTLETS

- A. Contractor shall coordinate the location of all outlets with the architectural furniture layouts and the Engineer and WSU C&IT.
- B. Contractor to furnish and install voice, data, and video jacks in face plates for flush and surface-mounted workstation outlets.
- C. Mount surface outlets securely in place in consistent locations on systems furniture. Coordinate with furniture installer.

12.5 FACE PLATES

- A. Contractor shall furnish and install faceplates on wall boxes and raceway as required and as indicated on the Drawings.
- B. Contractor shall provide standard faceplate with blank inserts for all outlets indicated as "future".

12.6 PATCH PANELS

- A. The Contractor shall provide patch panels and cable management panels in equipment racks, as required.
- B. Mount patch panel according to equipment rack elevations.

12.7 VOICE CONNECTING BLOCKS

- A. Contractor shall mount 110 style-connecting blocks on plywood backboard. Provide "D rings" & cable management between blocks.

END OF SECTION 17150

SECTION 17170 - CABLE PLANT ADMINISTRATION AND TESTING

PART 13 - GENERAL

13.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 17010 Section "Telecommunications General Requirements."

13.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NFPA-297 - Guide on Principles and Practices for Communication Systems.
- C. ANSI/TIA/EIA 568-B-1,2,3 - Commercial Building Telecommunications Cabling Standard.
- D. ANSI/TIA/EIA 569-A - Commercial Building Standard for Telecommunications Pathways and Spaces.
- E. ANSI/EIA/TIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications.
- F. ANSI/IEEE-110-1992 - Powering and Grounding Sensitive Electronic Equipment.
- G. BICSI – Building Industry Consulting Services International.

13.3 SUBMITTALS

- A. Submit under provisions of Section 17010.
- B. Product Data: Provide for all cable and device labeling apparatus.
- C. Reports: Submit final, certified test reports in bound booklet and electronic media. Include signed and dated reports certifying the test results.

13.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 17010.
- B. Accurately record equipment layout and cable layouts in all telecommunication spaces.

13.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 16010.
- B. Protect products from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

13.6 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduits, and cable pathways prior to rough-in.

PART 14 - PRODUCTS

14.1 LABELS

- A. Manufacturers:
 - 1. Brady.
 - 2. Brother P-Touch.
 - 3. Equivalent by Tester manufacturer.
 - 4. Equivalent by UTP connectivity manufacturer.
- B. Description
 - 1. Machine-printed permanent glossy polyester labels for racks, cabinets, faceplates, and panels. (Brady B-422).
- C. Machine-printed, self-laminating vinyl for cabling and patch cords. (Brady B-427)

PART 15 - EXECUTION

15.1 LABELING

- A. Contractor to install all faceplate and equipment labels in accordance with manufacturer's recommendations and the specifications. All labels shall be

neatly installed and shall be level with the floor and properly aligned on the faceplate.

- B. All pieces of voice and data equipment, including wires, cables, fibers and their respective terminations shall be labeled and identified in accordance with ANSI/TIA/EIA Standard 606.
- C. Labels shall meet the requirements of UL 969 as outlined in the ANSI/TIA/EIA Standard 606.
- D. All horizontal and backbone subsystem copper and fiber cables shall be labeled at each end. Labeling is required at intermediate points such as pullboxes and consolidation points (where appropriate).
- E. Do not install labels closer than 3" to the termination point.
- F. Patch panel labels shall be printed with the associated user data jack number. Contractor shall submit a sample of patch panel label strips to the Engineer for approval prior to installation.
- G. Numbering schemes for fiber panels, copper patch panels & voice wall 110 punch blocks will go in ascending order.
- H. Intra-building fiber riser cable labeling scheme is for building riser cables between communication rooms, [cable type]-[WSU Building Number]-[floor number]-[communication room number]. Example: BRC-027.03.315
- I. Voice & data jack labeling scheme is [Room Number] – [jack number + function]. Ex: 222-V01, 222-D01, 222-V02, 222-D02, 223-V01, 223-D01, etc labeling shall be consistent at each end of cabling and at workstation outlet and patch panel or connecting block. Data jacks shall be orange located in the outlet bottom position (vertical) or the outlet right position (horizontal). Voice jacks shall be White located in the outlet top position (vertical) or the outlet left position (horizontal).
- J. Wireless access point jacks labeling scheme is [WAP] - [Room Number]. If the access point is in a corridor, use the closest room number. Labeling shall be consistent at each end of cabling and at WAP outlet and patch panel or connecting block.
- K. Security camera jacks labeling scheme is [CAM] - [Room Number]. If the security camera is in a corridor, use the closest room number. Labeling shall be consistent at each end of cabling and at WAP outlet and patch panel or connecting block.
- L. All access point & security camera jacks will be terminated on their own patch panel separate from the workstation data patch panels.
- M. All labels must be based on the final room numbers. Verify room numbering with Owner prior to installation of labels. Do not use room numbers that appear on construction drawings.

15.2 UTP SYSTEM TESTING

- A. Upon completion of the cable installation, the Contractor shall perform complete copper cable certification tests, according to all manufacturer's requirements for warranty and all testing required by TIA/EIA, including, but not limited to:
 - 1. Continuity checks on each cable, checking for opens and shorts.
 - 2. Cable length (Channel and Permanent Link).
 - 3. Correct pair polarity.
 - 4. Correct cable labeling at both ends.
- B. Tests shall be performed with connectors installed.
- C. Any outlet, cable or component not satisfactorily passing tests or failing to meet quality installation standards as described in the specification, shall be repaired and/or replaced as directed by the Engineer at the Contractor's expense.
- D. The Contractor shall prepare complete cable test reports for all installed cables for review and acceptance by the Engineer WSU C&IT prior to acceptance of the cabling system.
- E. Category 6E UTP cable and patch cord installations shall be fully tested and verified in accordance with TIA/EIA-568-B specifications.
- F. All cable testing shall be conducted by an experienced technician using a Microtest Omni Scanner, or Agilent Technologies (HP/Scope Communications) WireScope 350, or Engineer-approved equal for certification testing.
- G. The cable tester shall be calibrated to the type of cable being tested prior to beginning the cable certifications. It should identify each cable or jack number on the test results.
- H. Descriptions of the proposed calibration procedure shall be submitted to the Engineer for approval prior to beginning any testing.
- I. The Category 6E Horizontal Cable Certification reports shall have complete testing of Permanent Link for voice drops and Channel for data drops, at frequency increments up to 250MHz as indicated in TIA/EIA-568-B and shall include the following:
 - 1. Cable/Faceplate Number -- matching faceplate numbers on patch panels
 - 2. Test Date
 - 3. Cable Length
 - 4. Wire-Map
 - 5. Network Tests for 100BASE-TX and 1000BASE-T
 - 6. Attenuation
 - 7. Near End CrossTalk (NEXT)
 - 8. Power-sum NEXT (PS-NEXT)
 - 9. Attenuation to Cross Talk Ratio (ACR)
 - 10. Power-sum Attenuation to Cross Talk Ratio (PS-ACR)

11. Equal Level Far End CrossTalk (ELFEXT)
 12. Power-sum Equal Level Far End CrossTalk (PS-ELFEXT)
 13. Return Loss
 14. Propagation Delay
 15. Delay Skew
 16. Signal to Noise Ratio
- J. Upon completion, before final payment the following must be provided:
1. Provide (1) electronic copy of test results in PDF file format.
 2. Provide the manufacture warranty certificate upon completion.
 3. Test date.
 4. Tester make and model no.
 5. No exception to this will be allowed.
- K. After the horizontal cable tests have been performed, the Contractor shall install the faceplate labels and modular jack dust covers.

15.3 OPTICAL FIBER SYSTEM TESTING

- A. Upon completion of the fiber cable installation, the Contractor shall perform complete fiber cable certification tests, according to all manufacturer's requirements for warranty and all testing required by TIA/EIA.
- B. Test all fiber (100%) using a power meter, testing all cables in both directions.
- C. Provide test report and include as a minimum the following information for all cables:
1. Fiber cable number
 2. Fiber length.
 3. Attenuation (loss in dB).
 4. Test date
 5. Tester make and model no.
 6. Tester calibration date.
- D. All cable testing shall be conducted by an experienced technician using a Microtest Simplifiber meter or equivalent tester.

END OF SECTION 17170

SECTION 17500 – C&IT CATV SPECIFICATIONS AND TESTING

PART 16 - GENERAL

16.1 CONDITIONS AND RELATED DOCUMENTS

- A. All work shall conform to the most current revision of WSU Standards for Communications Infrastructure, which is available online at:

<http://ucomm.wayne.edu/WSU-Communications-Standards.pdf>

- B. The System shall allow the building Owner the capability of providing and regulating the distribution of digital and analog Standard Definition Television (SDTV) and High Definition Television (HDTV) channels and media to each individual jack or outlet.
- C. Prior to start of work, the Contractor's design and plan shall be reviewed and approved in advance by WSU C&IT Computing & Network Services. The representatives from WSU C&IT Computing & Network Services shall be David Fleig, 313-577-0845 and Pete Garabedian 313-577-1955.
- D. For requirements of work in existing buildings refer to Section 17010 and as otherwise noted herein. Coordinate all work with WSU C&IT Computing & Network Services and WSU FP&M for access to buildings and telecommunications spaces, and building occupancy schedules.
- E. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including labor, materials, equipment and incidentals necessary and required for their completion.
- F. All work shall be in compliance with the most current NEC, NFPA, state and local codes, ordinances and regulations of any other governing body having jurisdiction.
- G. The Contractor shall provide references and shall show evidence of having successfully completed at least three similar projects. Site visits may be required at the discretion of WSU C&IT Computing & Network Services.
- H. The Contractor shall provide a list of all its subcontractors. The Contractor shall provide references for each subcontractor showing evidence of their having successfully completed at least three similar projects. Site visits may be required at the discretion of WSU C&IT Computing & Network Services.
- I. The Contractor shall show evidence upon request that he maintains a fully equipped service organization capable of furnishing adequate certification, testing, inspection and service to the System, including replacement parts. Site

visits may be required at the discretion of WSU C&IT Computing & Network Services.

- J. After completion of the contract, the Contractor shall furnish two complete sets of operating instructions and other information necessary for proper installation and maintenance of System components.
- K. As-built drawings and documentation of the System performance shall be provided in three ring binders and supplied in both CD and hardcopy formats.
- L. AutoCad shall be used for all drawings supplied on CD. Microsoft Word or Adobe PDF shall be used for all word-processed files and related documentation supplied on CD.
- M. All electronic equipment and cable shall be new and shall be products of a manufacturer of established reputation and experience. The manufacturer shall have supplied similar apparatus to comparable installations rendering satisfactory service for at least three years.
- N. The Contractor shall furnish all necessary equipment, labor and installation materials whether specified or not to provide a complete turnkey, operating System.
- O. All equipment and cables shall be installed according to accepted construction regulations and practices and shall comply with manufacturers' recommendations.
- P. Pull strings shall be installed in all pathways.
- Q. All pathways and cores shall be firestopped as required per the attached Section 17110 document.

16.2 DRAWINGS

- A. The drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as possible as the construction will permit.
- B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly; provide such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.
- C. Deviations from the drawings, with the exception of routing and other such incidental changes that do not affect the serviceability of the System, shall not be made without the written approval of WSU C&IT Computing & Network Services.
- D. The architectural and structural drawings take precedence in all matters pertaining to the building structure, mechanical drawings in all matters pertaining to mechanical trades and electrical drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the drawings for the

various trades, report such conflicts or differences to WSU C&IT Computing & Network Services for resolution. The Architect/Engineer does not have authority to approve any changes due to conflicts in documents. Approval must come from WSU C&IT Computing & Network Services Department. Primary contact is Pete Garabedian (313) 577-1955 backup contact is Dave Fleig (313) 577-0845.

16.3 STANDARDS, CODES AND REFERENCES

- A. ANSI/TIA/EIA-568-B-1,2,3 Commercial Building Telecommunications Standard
- B. ANSI/NFPA 70 National Electrical Code, Latest Edition
- C. FCC Part 15 Radiation Limits
- D. FCC Part 76 Cable Television Service
- E. BICSI TDMM Telecommunications Distribution Methods Manual, Latest Edition
- F. DOCSIS 3.0 or later Cable Television Standards

16.4 PROJECT CONDITIONS

- A. Verify field measurements are as shown on Drawings.
- B. Verify suitability of all pathways prior to cable installation.

16.5 SUBMITTALS

- A. Product Data Sheets
 - 1. Submittals shall be complete and bound in 3-ring binders or similar fashion for WSU C&IT Computing & Network Services approval prior to ordering equipment.
 - 2. The binders shall contain manufacturer's product data sheets for the specific items to be installed for this Project.
 - 3. Contractor shall highlight or identify each specific item to be installed, by catalog number, on each product data sheet. The Contractor shall indicate specific color, style, configuration, etc., and all accessories specified for a complete, turnkey installation.
 - 4. Contractor shall provide detailed line item pricing and a bill of materials for all aspects of the System.
 - 5. Provide product data sheets for all specified and required products prior to purchase of any materials.

B. Layout Drawings

1. Submit layout drawings to scale for all cable television systems indicating all active and passive equipment, taps, splitters, jacks, and cable routing.
2. Submit summary of results based on calculations required to layout each trunk, branch, system or subsystem including dB loss budgets and bandwidth. Identify dB loss and bandwidth of every component.
3. Provide layout drawings prior to installation of any materials.

16.6 CATV BROADBAND SYSTEM DESCRIPTION

- A. The System shall utilize trunk and branch topology.
- B. The System shall utilize 0.500 inch diameter hard-line trunk with RG-6U branches. The System may utilize RG-11U Quad Shield, Double-braided coaxial trunk cable with RG-6U branches in special cases. Use of RG-11U trunk cable shall be determined and permitted solely by the representatives of WSU C&IT Computing & Network Services.
- C. The System shall allow the building Owner the capability of providing and regulating the distribution of digital and analog Standard Definition Television (SDTV) and High Definition Television (HDTV) channels and media to each individual jack or outlet.
- D. Branch circuits shall be tapped directly into the trunk and shall be home runs from the nearest trunk tap.
- E. No taps, couplers, splitters, amplifiers or splices shall be allowed between the trunk taps and wall jacks/drops.
- F. All in-line amplifiers shall be remote-powered from the first floor building communications MDF.
- G. Each residence room shall be furnished with two wall jacks/drops and shall be located per System drawings and field conditions.
- H. Designated common areas and offices shall be provided with one or more wall jacks/drops and shall be located per System drawings and field conditions.
- I. System input shall be a single point within the building MDF at which signals from various sources shall be injected.
- J. Accessibility for the addition of individual channel filter/traps shall be provided.
- K. Each hard line trunk shall be served by its own amplifier.
- L. System input shall be buffered with its own amplifier.

PART 17 - BROADBAND NETWORK SPECIFICATION

17.1 BANDPASS AND SPECTRUM ALLOCATION

A. Bandpass: 5MHz to 1000 MHz

1. Bandpass of passive devices and equipment shall be 5 MHz to 1000 MHz.
2. Bandpass of active amplifiers shall be 5 MHz to 870 MHz minimum.

B. Spectrum Allocation:

1. Forward: 54 MHz to 1000 MHz
2. Return: 5 MHz to 42 MHz

C. Reference Level

1. All levels of head end equipment shall be referenced to a 56 dBmV visual carrier of a television channel, forward and return.

D. Outbound Carrier To Composite Triple Beat

1. The ratio of any visual referenced carrier level to the peak distortion density level of all triple beat products within carrier bandpass shall be greater than 51 dB for the last amplifier in the trunk cascade.

E. Outbound Carrier To Noise

1. The ratio of any visual referenced carrier level to RMS noise across a 4.2 MHz bandwidth shall be 46 dB or greater.

F. Forward Carrier To Noise Ratio

1. The ratio of any forward originated visual referenced carrier's peak level to RMS noise level shall vary with the number of amplifiers in cascade (N) as follows:

N	C/N Not Less Than	N	C/N Not Less Than
1	57 dB	5-8	48 dB
2	54 dB	9-15	45 dB
3-4	51 dB	16-20	43 dB

G. Return Carrier To Noise Ratio

1. The ratio of any return visual referenced carrier's peak level to RMS noise level shall vary with the total number of amplifiers (N) in the return network as follows:

N	C/N Not Less Than	N	C/N Not Less Than
1	57 dB	9-15	45 dB
2	54 dB	16-30	42 dB
3-4	51 dB	31-50	40 dB
5-8	48 dB	51-100	37 dB

H. Carrier To Hum

1. The percentages of any visual referenced carrier level to hum (100% modulation) shall be less than 3%.

I. Gain versus frequency response

1. The frequency response across any 1 MHz shall be flat within +/- 2 dB as measured at any amplifier test point or outlet in the System.
2. Peak to valley.
3. The network peak to valley frequency response across any 18 MHz shall be less than 3 dB between adjacent carriers.

J. Carrier to second order intermodulation

1. The ratio of any visual referenced carrier level to any second order intermodulation products within the carrier bandpass shall be 51 dB or greater.

K. Outlet signal level

1. Forward visual referenced carrier level at any user point in the System shall be between +3.0 dBmV (minimum) and +15.0 dBmV (maximum) across the forward bandpass.

L. Return Level

1. Return visual referenced carrier level at the output of the return combiner shall be +10 dBmV +/- 5 dB across the return bandpass.

M. System or network radiation

1. System or network RF radiation shall conform to FCC Section 76.605 (a) (12). As measured by tuned dipole antenna, System radiation shall not exceed the following limits:

- a. 54 MHz to 216 MHz 15 μ V/meter at 30 meters
- b. Greater than 216 MHz 20 μ V/meter at 3 meters & 15 μ V/meter at 30 meters

PART 18 - EXECUTION

18.1 GENERAL

- A. All equipment shall be held firmly in place and supported by fastenings, brackets, etc. capable of supporting the load.
- B. Boxes, equipment cabling, racks, etc. shall be installed and secured plumb and square with building lines.
- C. In the installation of equipment and cable, consideration shall be given to operational efficiency, serviceability and overall aesthetics shall be determined by WSU C&IT Computing & Network Services.
- D. All cable, regardless of length, shall be marked with machine-generated, wrap-around numbered or lettered markers at both ends, and sealed with clear heat-shrink covers. There shall be no unmarked cables in the System. Marking codes shall be keyed to the floor and room number and shall be shown on the drawings. Marking nomenclature shall be approved prior to cable installation by WSU C&IT Computing & Network Services. Submit proposed nomenclature scheme with shop drawings and product data for approval by engineer and owner. Refer to Section 17010 for requirements.
- E. Terminal blocks, boards, strips or connectors shall be furnished for all cables that interface with racks, cabinets, consoles or equipment modules.
- F. All cables associated with the cable television System shall be grouped according to signals being carried in order to reduce signal contamination or interference. Grouping of cables shall adhere to the WSU Standards for Communications Infrastructure. Separate groups shall be formed for the following:
 - 1. Power cables.
 - 2. Control cables
 - 3. Cable television/RF cables.
- G. All branch cables shall be cut to the length dictated by the run and shall include a minimum 3 foot service loop at the trunk end, for repair purposes or future uses.

- H. All trunk cables shall be cut to the length dictated by the run and shall include a minimum 25 foot service loop at the head end/MDF end, for repair purposes or future uses.
- I. For equipment mounted in drawers or slides, the interconnecting cables shall be provided with a service loop of appropriate length.
- J. All cables run in plenum areas shall be installed in cable trays provided by the Electrical Contractor or securely and independently supported using J-Hooks from the building structure at a maximum 4 feet on center. Bridal rings shall not be allowed.
- K. Cable shall not be laid on ceiling grid, light fixtures, plumbing, conduit, piping, ducts, etc. Cable shall not be attached to ceiling grid supports or tied to existing electrical conduit, conduit hangers, light fixtures, plumbing, plumbing hangers, piping, ducts, duct hangers, etc.
- L. All cables in vertical riser shall be strain-relieved at each floor.
- M. Cables installed in air return spaces or plenum spaces shall be plenum-rated per NFPA codes.

18.2 PRODUCTS

A. Trunk Cables

1. Cable shall be 0.500 inch diameter hard-line.
2. Cable shall be plenum-rated.
3. Cable shall be Commscope 2312K. Substitutions must be approved in advance by WSU C&IT Computing & Network Services.
4. In the special-use case of RG-11U coaxial trunk cable, all cable shall be Commscope 2287K plenum-rated. Use of RG-11U cable must be approved in advance by WSU C&IT Computing & Network Services.
5. Cable shall have a nominal impedance of 75 Ohms.
6. Cable shall be sweep-tested by its manufacturer, passed and certified as such by its manufacturer and shall be certified as its best grade over its entire rated bandwidth. A written copy of the certification shall be provided to WSU C&IT Computing & Network Services and shall be included with the Submittals and As-built documentation.

B. Coaxial branch/drop cable

1. Cable shall be RG-6U, 98% or higher RFI shield rating, quadshielded, doublebraided.
2. Cable shall be plenum-rated.

3. Cable shall be Commscope 2227V. Substitutions must be approved in advance by WSU C&IT Computing & Network Services.
4. Cable shall have a nominal impedance of 75 Ohms.
5. Cable shall be sweep-tested by its manufacturer, passed and certified as such by its manufacturer and shall be certified as its best grade over its entire rated bandwidth. A written copy of the certification shall be provided to WSU C&IT Computing & Network Services and shall be included with the Submittals and As-built documentation.

C. Trunk cable taps, Directional couplers, Splitters, Equalizers

1. Taps, couplers, splitters and equalizers shall be manufactured by C-Cor, Philips or equal. Substitutions must be approved in advance by WSU C&IT Computing & Network Services.
2. Taps, couplers, splitters and equalizers shall be trunk power-bypass and RF-bypass type.
3. Removal of a tap, coupler, splitter or equalizer cover shall not interrupt or disable the trunk power bypass or the RF bypass.
4. Taps shall not pass trunk power to the individual branch circuits, drops and wall jacks. Branch circuit taps shall be passive and shall not be powered by trunk power.
5. Taps, couplers, splitters and equalizers shall be of a type and size specifically designed for 0.500 inch diameter hard-line cable and connectors.

D. Trunk connectors

1. Connectors shall be Pyramid, LRC, Gilbert, Commscope or equal. Substitutions must be approved in advance by WSU C&IT Computing & Network Services.
2. Trunk connectors shall be of a two-piece design. Three piece connectors shall not be allowed.
3. Connectors shall be Cable Television Service, FCC Part 76 certified.
4. Connectors shall be of a type and size specifically designed for 0.500 inch diameter hard-line cable or RG-11U coaxial cable, as required.
5. If RG-11U coaxial cable is used, connectors shall be Thomas & Betts "Snap-n-Seal".
6. Connectors shall have a nominal impedance of 75 Ohms.

E. Branch cable connectors

1. Connectors shall be Thomas & Betts "Snap-n-Seal". Substitutions must be approved in advance by WSU C&IT Computing & Network Services.
2. Connectors shall be Cable Television Service, FCC Part 76 certified.
3. Connectors shall be of a size and type specifically designed for RG-6U Commscope 2227V plenum-rated cable, the trunk taps and the wall jacks. Computing & Network Services representatives shall approve these connectors in advance prior to the start of work.
4. Connectors shall be of a one-piece design. Two-piece connectors shall not be allowed.
5. Connectors shall have a nominal impedance of 75 Ohms.

F. Trunk amplifiers, line extenders

1. Amplifiers and extenders shall be C-Cor Flexnet NL Series or equal. Substitutions must be approved in advance by WSU C&IT Computing & Network Services.
2. Amplifiers and extenders shall be subsplit capable.
3. Amplifiers and extenders shall be designed to allow for remote trunk power and trunk power bypass.
4. Amplifiers and extenders shall be of a type and size specifically designed for 0.500 inch diameter hard-line cable and connectors.
5. Amplifiers shall be gain adjustable and equalizable.
6. Amplifiers and extenders shall be backboard mounted in the MDF.
7. Amplifiers shall have a minimum bandwidth of 862 MHz.

G. Line power inserters

1. Line power inserters shall be Philips 9-LPI or equal. Substitutions must be approved in advance by WSU C&IT Computing & Network Services.
2. Inserters shall be of a type and size specifically designed for 0.500 inch diameter hard-line cable and connectors.

H. Power supplies

1. Power supplies shall be Exide or Lectro "Broadband" series or equal and shall be compatible with the 0.500 hardline-equipped amplifier and line extender array.
2. Power supplies shall be fed from 120 volts AC.

3. Power supplies shall be hardwired to a dedicated, separate 120 VAC branch circuit. Coordinate installation with electrical trades as required.
 4. Power supplies shall be backboard mounted in the MDF.
- I. Coax jacks and wall plates, wall connectors
1. Wall jacks/connectors shall be "Grayfox Gold #7530." NO SUBSTITUTIONS ALLOWED.
 2. Wall jack connectors shall be type F.
 3. Wall jacks shall be 75 Ohm, SELF-TERMINATING.
 4. Wall jacks and connectors shall have a nominal impedance of 75 Ohms.
 5. Wall plates shall be satin finish, stainless steel, square corner, sized to match junction boxes.
- J. Jumper cables
1. Provide a sufficient number of twelve foot, black, 75 Ohm, type F coaxial jumper cables for use to connect television sets and VCR's to CATV outlets.
 2. Coaxial jumper cables are not required to be plenum-rated.
 3. Coaxial jumper cables shall be press-on/friction fit type. Screw-on connectors shall not be allowed.
 4. Coaxial jumper cables shall be compatible with the building CATV outlet connectors.
- K. Security at trunk line taps (IF required)
1. All connectors shall be equipped and installed with security shields.
- L. Unused taps
1. At any point in the system, all unused taps shall be terminated into precision, passive 75-Ohm terminators of appropriate size and wattage. Security provisions at trunk line taps shall apply.

18.3 SYSTEM PERFORMANCE AND TESTING

- A. All aspects of Section 1.8 BROADBAND NETWORK SPECIFICATIONS shall be tested and documented.

- B. Three sets of written test results shall be provided to WSU Computing & Network Services (C&IT) in 3-ring binders and on CD-ROM.
- C. System testing shall be performed by an independent testing company not affiliated with the System Contractor.
- D. System testing and methods shall be approved in advance by WSU Computing & Network Services (C&IT).
- E. All system testing shall be supervised by WSU Computing & Network Services (C&IT)
- F. System acceptance testing shall be subject to WSU Computing & Network Services (C&IT) inspection and approval of installation, workmanship, products, performance testing and documentation.

18.4 RELATED SYSTEMS AND FACILITIES (IF REQUIRED)

- A. Inter/Intra building signal transport system
 - 1. Provide a fiber optic CATV transport system to deliver all channels, whether active or not, across the specified bandwidth from the existing MDF. System shall be compatible and shall match the existing WSU transmit and receive systems. Substitutions shall not be allowed.
 - 2. The transport system shall feed the existing CATV programming to the new CATV broadband system for distribution to all CATV outlets.
 - 3. Signals shall be transported between buildings via the WSU single mode fiber optic backbone network.
 - 4. Signals shall be interfaced to the WSU fiber optic backbone network via WSU fiber optic patch panels located in each building's MDF.
 - 5. The transmitting end of the system shall have a minimum six fiber optic outputs for use with the inter-building transport system, monitoring systems and for future expansion.
 - 6. The system shall have an auxiliary input to allow delivery of programming from remote locations elsewhere on campus via the WSU single mode fiber optic backbone network.
 - 7. Fiber optic patch panels and patch cords shall be provided to interface all system inputs and outputs to the WSU fiber optic patch panels.
 - 8. Performance of the transport system shall meet or exceed the specifications of the CATV system specified within Section 17500 and

shall not impair, limit, change or reduce the quality or specifications of the existing CATV systems.

9. All fiber optic equipment shall be rack-mounted or backboard mounted. Mounting methods shall be approved in advance by WSU C&IT Network Services.
10. Fiber optic transmitter power levels shall be designed with sufficient headroom to compensate for practical and theoretical losses within the WSU fiber optic network and any passive optical splitters.
11. All singlemode fiber-optic connectors and ferrules shall be SC/APC. Color shall be green.

B. Local monitoring system

1. Provide a CATV monitoring television set within the MDF similar to the existing set in the WSU Headend.
2. The monitoring television set shall be rack mounted and shall be capable of viewing all CATV channels, whether active or not.
3. The CATV monitoring television shall be rack-mounted in the building MDF or its CATV distribution point.

END OF SECTION 17500

DIVISION 28 ELECTRONIC SAFETY AND SECURITY

SECTION 283111 – DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. The WSU Department of Public Safety remotely monitor essentially all of the University buildings on campus and monitor all of the fire alarm systems, 24-hours a day. The Department of Public Safety is considered to be a constantly attended location.
- B. Provide a new fire alarm system with the following features:
 - 1. A main fire alarm control panel (FACP).
 - 2. Node and notification appliance circuit (NAC) panels.
 - 3. Automatic and manual initiating devices.
 - 4. Audible and visual notification appliances.
 - 5. Control inputs and outputs to building ventilation (HVAC) systems.
 - 6. Alarm, supervisory and trouble outputs to the alarm transmitter.
 - 7. Raceways, junction boxes, wiring and accessories as required for a complete and operable system.
 - 8. System programming in accordance with the system's sequence of operation.
 - 9. Remote annunciator with microphone.
 - 10. Supervision signaling.
 - 11. Firefighter's two-way telephone communication service.
 - 12. Emergency voice/alarm communications.
 - 13. New fire alarm system (Base Bid) shall include components to monitor and control the following building equipment/systems:
 - a. Fire pump.
 - b. Emergency generator (future).
 - c. Fire suppression system suitable for high-rise building application with sprinkler water flow switches and OS&Y valves zoned per floor.

1.2 RELATED SECTIONS

- A. The drawings and the general provisions of the contract apply to this section.

- B. The applicable requirements of the other Division 26 specification sections, including the following, apply to this section.
 - 1. Section 260500, "Basic Electrical Materials and Methods".
 - 2. Section 260519, "Cables and Wires".
 - 3. Section 260526, "Grounding".
 - 4. Section 269500, "Electrical Acceptance Tests".

1.3 REFERENCES

- A. Comply with the current versions of the following codes and standards as applicable:
 - 1. ANSI/IEEE C2, "National Electrical Safety Code".
 - 2. MBC, "Michigan Building Code".
 - 3. MMC, "Michigan Mechanical Code".
 - 4. NFPA 13, "Standard for the Installation of Sprinkler Systems".
 - 5. NFPA 70, "National Electrical Code".
 - 6. NFPA 72, "National Fire Alarm Code".
 - 7. UL 217, "Single and Multiple Station Smoke Detectors".
 - 8. UL 268, "Smoke Detectors for Fire Protective Signaling Systems".
 - 9. UL 268A, "Smoke Detectors for Duct Applications".
 - 10. UL 464, "Audible Signal Appliances".
 - 11. UL 521, "Heat Detectors for Fire Protective Signaling Systems".
 - 12. UL 864, "Control Units for Fire Protective Signaling Systems".
 - 13. UL 1480, "Speakers for Fire Protective Signaling Systems".
 - 14. UL 1971, "Signaling Devices for the Hearing Impaired".
- B. Comply with the applicable sections of NFPA 101, "Life Safety Code".

1.4 SYSTEM DESIGN REQUIREMENTS

- A. The system shall be power limited.
- B. Provide a fire alarm control panel with the following:
 - 1. Digital display.
 - 2. Multiple pushbutton keypad.

3. LED status indicating lights.
 4. Audible status signals.
 5. Output relays.
 6. Battery charger and batteries.
 7. RS-232 communications card.
- C. Provide Class A, signaling line circuits.
1. Provide sufficient spare capacity on each signaling line circuit for an additional 25 percent of initiating and control devices.
- D. Provide Class A, notification appliance circuits.
1. Size the control panel power supplies, amplifiers and batteries for 25 percent spare capacity calculated with 40 ma horn loads, 1 watt speaker loads and 150 ma strobe light loads.
 2. Provide sufficient spare capacity on each notification appliance circuit for an additional 25 percent of notification appliances.
 3. The new fire alarm system shall be capable of incorporating future mass notification features including devices that accommodate voice, tone, and strobe.
- E. The system shall supervise the following circuits and components:
1. Initiating device circuits.
 2. Signaling line circuits.
 3. Notification appliance circuits.
 4. Addressable initiating and control devices.
 5. Control output wiring.
 6. Auxiliary control switches.
 7. System node panels, NAC panels, and remote annunciator.
 8. Primary power supply.
 9. Secondary power supply.
- F. The system shall be capable of being programmed by the Owner on site to accommodate expansion or sequence of operation changes.
- G. Provide 120 volts AC primary power to the system from a dedicated power branch circuit.
- H. Provide a control panel battery charger capable of fully charging a 200 amp-hour battery within 24 hours.

- I. Provide sufficient secondary power battery capacity to operate the entire system upon the loss of primary power for a period of 24 hours in a normal supervisory mode followed by 5 minutes of evacuation alarm operation.
 - 1. For emergency voice/alarm communications, provide sufficient battery capacity for 24 hours of operation in a normal supervisory mode followed by 15 minutes of voice/alarm operation.
 - 2. The system shall automatically transfer to and from the secondary power batteries upon an interruption of primary power without initiating a nuisance alarm.
- J. Provide smoke and heat detectors as required by code and as shown, including the following.
 - 1. Provide a smoke detector above each fire alarm control panel, node panel, and remote microphone panel.
 - 2. Provide a smoke detector in each mechanical, electrical, storage and telecommunications room.
 - 3. Provide duct smoke detectors where required by code. When not in plain view, provide duct detectors with remote alarm indicators and test switches mounted in plain view at 48 inches above the floor.
- K. Provide sufficient audible notification appliances to achieve a sound level of 15 dBA above ambient sound level, but not less than 75 dBA nor more than 120 dBA. The sound level in mechanical rooms shall be not less than 90 dBA.
- L. Provide visual notification appliances in accordance with the intensity and spacing requirements of NFPA 72.
 - 1. Provide strobes in all public areas including multi-person offices.
 - 2. Combine speakers with strobes when both are required at the same location.
 - 3. Synchronize strobes when more than two appliances are in any point of view.
 - 4. Provide strobes in mechanical rooms and other areas that have an average ambient noise level exceeding 60 dBA.
- M. Provide a waterproof horn/strobe or speaker/strobe with waterproof back box on the exterior of the building between 8 and 12 feet above the fire department connection. Audible sound shall be 90 dBA minimum at 10' and visual intensity shall be 110 candela. Program this device to alarm upon sprinkler system water flow only, and to cease operation upon termination of water flow.
- N. Provide individually addressable monitor modules to monitor non-addressable initiating devices and status contacts of other systems.
 - 1. Monitor modules shall use Class A initiating device circuits to monitor the initiating devices and status contacts.
- O. Provide panel auxiliary relay contacts and individually addressable control module contacts to interface with control circuits of other systems and equipment.

1. Provide normally closed duct smoke detector contacts to shut down ventilation systems.
- P. Assign each initiating device a unique device address.
- Q. Develop a custom location label for each initiating device that describes the type, floor, room number and exact location of the device.
1. If the device is in a corridor or similar large space, state device by Room XXX.
 2. If room numbers are not available, provide compass directions and references to unique building features.
- R. Provide transient voltage surge suppression for the system.
- S. Connection to Sprinkler System – Monitor water flow switches to detect sprinkler activation, and valve tamper switches. Fire panel description shall specifically note coverage area of the water flow, and the locations of the tamper switches.
- T. Monitored components such as flow switches, tamper switches, etc. shall be connected (and monitored) by addressable “monitor module” device. Monitor modules shall be connected to the monitored device, and shall be in close proximity to that device.
- U. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector’s location within the system and its sensitivity setting.
 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- V. Duct Smoke Detectors:
1. Locate duct smoke detectors at locations defined by manufacturer and/or by the code to have a laminar flow across the detector. Do not locate duct type smoke detectors downstream of humidity injection points or in outside air intake plenums. Duct smoke detectors shall ‘report’ to the fire alarm panel and the fire alarm panel shall operate a ‘control module’ to stop the associated fan.
 2. Typically all duct smoke detector installations shall include a ‘duct detector interface box’.
 3. Connect panel for transmission of alarm, supervisory, and trouble signals to the Department of Public Safety. Program the duct detectors as supervisory rather than alarm devices.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. Under normal conditions, the control panel digital display shall display a "SYSTEM NORMAL" message and the current time and date.
- B. Should an abnormal condition be detected, the appropriate alarm, supervisory, or trouble panel LED shall flash and the appropriate panel audible signal shall sound.
- C. The appropriate panel alarm, supervisory and trouble output relay contact shall close and send a signal through the alarm transmitter to the Department of Public Safety.
- D. The panel shall display the following information relative to the abnormal condition:
 - 1. Custom location label (40 characters minimum).
 - 2. Type of initiating device.
 - 3. Type of abnormal condition (alarm, supervisory or trouble).
- E. If the abnormal condition is an alarm, the following actions shall occur:
 - 1. Audible notification appliances shall sound throughout the building.
 - 2. Visible notification appliances shall flash throughout the building.
 - 3. Control outputs to mechanical systems shall perform their programmed functions.
- F. Pressing the appropriate Acknowledge pushbutton shall acknowledge the alarm, supervisory or trouble condition unless the system is in the silence inhibit mode. Once acknowledged, the appropriate LED shall latch on and the panel audible signal shall be silenced.
- G. If the abnormal condition is an alarm, pressing the Acknowledge pushbutton shall silence the audible notification appliances. The visual notification appliances shall continue to flash until the system is reset.
- H. In addition to the Acknowledge pushbutton available on the fire alarm control panel, the fire alarm system head end equipment in the Department of Public Safety shall be capable of acknowledging the system and silencing the audible notification appliances remotely.
- I. Upon a subsequent abnormal condition from another device, the appropriate panel LED shall flash, the panel audible signal shall again pulse and the panel display shall show the new abnormal condition.
- J. After all of the points have been acknowledged, the LED's shall glow steady and the panel audible signal shall be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated.
- K. Pressing the System Reset pushbutton shall return the system to its normal state if the abnormal conditions have been remedied.
 - 1. The display shall step the user through the reset process with simple English language messages. Messages including "IN PROCESS", "RESET"

COMPLETED", and "SYSTEM NORMAL" shall provide operator assurance of the sequential steps as they occur.

2. The ventilation system motors shall restart sequentially.
3. The outputs to control circuits of other systems and equipment shall return to normal.
- L. Should an abnormal condition continue to exist, the system shall remain in an abnormal state. The system control relays shall not reset. The panel LED's shall remain on. The display shall indicate the total number of alarm, supervisory and trouble conditions present in the system along with a prompting to review the points. These points shall not require acknowledgment if they were previously acknowledged.
- M. Should a trouble condition continue to exist, the trouble audible signal shall resound at preprogrammed time intervals to act as a reminder that the fire alarm system is not 100 percent operational. Both the time interval and the trouble audible signal shall be programmable to suit the Owner's application.
- N. Should the Alarm Silence Inhibit function be active, the System Reset pushbutton shall be ignored and a "RESET INHIBITED" message shall be displayed for a short time to indicate that action was not taken. For operator assurance, a "RESET NO LONGER INHIBITED" message shall be displayed when the inhibit function times out.

1.6 SUBMITTALS

- A. Provide shop drawings for approval, and final certification reports, to the Office of Risk Management, and/or WSU Fire Marshall, as required by Code.
- B. Submit for approval copies of the following shop drawings and product literature. Shop drawings shall contain title blocks identifying the project name and number. Submittals shall be marked to indicate the specific models, sizes, types and options being provided. Submittals not so marked and incomplete submittals will be rejected.
 1. Plan drawings showing the locations of the system components, including any adjustments in the quantities and locations of initiating devices and notification appliances to meet code requirements.
 2. Riser diagram showing system components, interconnecting wiring and connections to other building systems and equipment.
 3. Wiring diagrams showing manufacturer and field connections at component terminals, complete with conductor color codes and wire numbers.
 4. System configuration list showing inputs, outputs, device addresses and custom location labels, device configurations and program logic.
 5. Bill of materials.
 6. Catalog pages showing system components.
 7. System battery sizing calculations.
 8. Power supply, amplifier and circuit sizing calculations.

1.7 EXTRA MATERIALS

- A. Provide to the Owner the following extra materials matching the products installed, packaged in protective coverings for storage, and identified with labels clearly describing the contents. Provide 1 percent of the installed amount of each with a minimum of one of each.
 - 1. Fuses: Each size and type used in the system.
 - 2. Manual Pull Stations.
 - 3. Detector Bases.
 - 4. Detector Heads: Each type used in the system.
 - 5. Addressable Monitor and Control Modules: Each type used in the system.
 - 6. Notification Appliances: Each size and type used in the system.
 - 7. Output Relays.
- B. Provide one data cable for connecting a lap top computer to the fire alarm control panel's RS-232 communications card so that the Owner can perform panel programming.

1.8 RECORD DOCUMENTS

- A. Submit four copies of record drawings showing the locations of fire alarm devices and appliances, the locations of end-of-line resistors and junction boxes, the addresses of addressable devices, the tap settings of audible notification appliances, the intensity ratings of visual notification appliances, the sizes of conduits and conductors, circuit numbers, and deviations from the design.
- B. Submit four printed copies of the final system configuration list showing inputs, outputs, addresses, custom location labels, device configurations and program logic.
- C. Submit electronic, Windows based files with the following final system software:
 - 1. The master program generic to the model of system being provided.
 - 2. The building specific program containing the unique information for the system being provided.
 - 3. A software license and the system passwords required by the Owner to perform programming changes.

1.9 OPERATIONS AND MAINTENANCE MANUALS

- A. Submit for approval four copies of operations and maintenance manuals for the specified system and equipment prior to startup. The manuals shall be the same manuals used by

the Manufacturer's field service technicians. The manuals shall be marked to indicate the specific models, sizes, types and options that were provided. Manuals not so marked will be rejected.

1.10 TRAINING

- A. Provide the Owner's Fire Alarm Technicians with training on the operation and maintenance of this model of system. This training shall be by the Manufacturer and shall be the same training as given to the Manufacturer's field service technicians. If the Owner's Technicians have already received operations and maintenance training from the manufacturer on this model of system, this training requirement will be waived.
- B. Train the Owner's Fire Alarm Technicians on unfamiliar components installed in this system.
- C. Walk the Owner's Fire Alarm Technicians through the building and identify the locations of fire alarm devices hidden from plain view.
- D. Train the Building Users, Department of Risk Management and the Department of Public Safety on the basic operation of the system, including how to acknowledge audible notification appliances after an alarm.
- E. Train the Building Users, Department of Risk Management and the Department of Public Safety and the Fire Inspectors on how to use the emergency voice/alarm communications and firefighter's two-way telephone systems. Invite representatives from the City of Detroit Fire Department to this training.
- F. Train the Facility Manager on how to use the emergency voice/alarm communications system for an emergency condition.

1.11 QUALITY ASSURANCE

- A. The fire alarm system shall be the standard product of a single fire alarm system manufacturer who has been producing this type of equipment for at least 10 years, and has a fully equipped service organization within 150 miles of the Owner. Each component shall display the manufacturer's name.
- B. Each fire alarm system component shall be listed under the appropriate standard of Underwriters Laboratories and shall bear a UL label.
- C. The fire alarm system shall be UL labeled as a system and approved by FM Global.
- D. The fire alarm system shall comply with the requirements of the National Fire Alarm Code, the Owner's Inspection Authorities and with the Manufacturer's instructions.

1.12 WARRANTY

- A. Provide a complete parts and labor warranty for twelve months from the date of final acceptance of the system by the Owner.
- B. Provide a telephone response to Owner's questions within 4 hours and on-site assistance within 24 hours.
- C. Permit Owner's Fire Alarm Technicians to perform temporary bypasses and emergency repairs on the system without voiding the warranty.

PART 2 - PRODUCTS

2.1 SYSTEM COMMUNICATIONS

- A. The fire alarm control panel shall communicate with each addressable initiating and control device individually via shielded twisted pair signaling line circuits.
- B. Each signaling line circuit shall be capable of accessing up to 127/250 addressable devices.
- C. Each signaling line circuit shall allow up to 10,000 feet of wire length to the furthest addressable device.
- D. Communications shall use a broadcast polling protocol to allow t-tapping of the circuit except where Class A wiring is required. T-taps shall be limited to 64 per loop.
- E. Communications shall be completely digital and shall include parity data bit error checking routines for address codes and check sum routines for the data transmission protocol.
- F. Each device shall be uniquely identified by a device address.
- G. There shall be no limit to the number of initiating devices which may be activated simultaneously.
- H. Each device shall be individually annunciated at the panel. Annunciation shall include the following conditions for each device.
 - 1. Alarm, supervisory or trouble condition.
 - 2. Open, short or ground.
 - 3. Device failure or incorrect device installed.

2.2 FIRE ALARM CONTROL PANEL

- A. The fire alarm control panel shall be modular with solid state, microprocessor based electronics.
- B. The panel shall display only those primary controls and displays essential to operation during a fire alarm condition.
- C. The panel shall include a LCD digital display, with a minimum of 80 characters.

1. The display shall be backlit for enhanced readability. It shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
 2. The display shall support both upper and lower case letters. Lower case letters shall be used for soft key titles and for prompting the user. Uppercase letters shall be used for system status information. A cursor shall be visible when entering information.
- D. A panel audible signal shall sound during alarm, supervisory or trouble conditions. This audible signal shall sound differently during each condition to distinguish one condition from another. The audible signal shall also sound differently during each key press to provide audible feedback (chirp) indicating that the key has been pressed properly.
- E. The system program shall be stored in a non-volatile memory within the panel. Loss of primary and secondary power shall not erase the program stored in memory.
1. The program shall be capable of selective input/output control functions based upon AND'ing, OR'ing, NOT'ing, timing and special coded operations.
 2. The program shall enable initiating devices to be individually configured on site to provide either alarm and trouble, supervisory and trouble, alarm only, supervisory only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a non-latching circuit or an alarm verification circuit.
 3. The program shall enable initiating devices to be disabled or enabled individually.
- F. The panel or the field devices shall determine the alarm decision for each detector by comparing the detector value to stored values.
1. The panel shall automatically maintain a constant smoke obscuration sensitivity in percent of smoke obscuration format for each detector.
 2. The panel shall maintain a moving average of each smoke detector's smoke chamber value to automatically compensate for dust and dirty conditions that could affect detection operation.
 3. The smoke obscuration sensitivity shall be adjustable to within 0.3 percent of either limit of the UL window (0.5 percent to 4.0 percent) to compensate for any environment.
 4. When a detector's average value reaches a predetermined value, a "MAINTENANCE ALERT" or "TROUBLE" condition shall be audibly and visually indicated at the panel. The LED on the detector base shall glow steady giving a visible indication at the detector location. If a dirty detector is left unattended and its average value increases to a second predetermined value, an "EXCESSIVELY DIRTY DETECTOR" or "TROUBLE" condition shall be indicated at the panel. To prevent nuisance alarms, these dirty conditions shall in no way decrease the amount of smoke obscuration necessary for system activation.
 5. The panel shall continuously perform an automatic self-test routine on each detector which shall functionally check detector electronics and ensure the accuracy of the obscuration values being transmitted to the panel. Any detector that fails this test shall indicate a "SELF TEST ABNORMAL" or "TROUBLE" condition at the panel.

6. Each detector shall be scanned by the panel for its type identification to prevent inadvertent substitution of another detector type. The panel shall operate with the installed device but shall initiate a "WRONG DEVICE" or "TROUBLE" condition until the proper type is installed or the programmed detector type is changed.
7. An operator at the panel, having a proper access level, shall have the ability to manually access the following information for each detector.
 - a. Device type.
 - b. Device status.
 - c. Present average value.
 - d. Peak detection values.
 - e. Present sensitivity selected.
 - f. Detector range (normal, dirty, etc.).
8. An operator at the panel, having a proper access level, shall have the ability to perform the following for each detector:
 - a. Enable or disable the point.
 - b. Clear peak detection values.
 - c. Clear verification tally.
 - d. Control a detector's relay driver output.
9. The panel shall be programmable to automatically change the sensitivity settings of each detector based on time-of-day and day-of-week (for example, to be more sensitive during unoccupied periods and less sensitive during occupied periods). There shall be seven sensitivity settings available for each detector.
10. The panel shall be programmable for a pre-alarm or two-stage function. This function allows an indication to occur when, for example, a detector with a 3 percent set point reaches a threshold of 1.5 percent smoke obscuration.
11. Smoke detectors shall be provided with the ability for alarm verification. When in alarm verification mode, only a verified alarm shall initiate the alarm sequence operation.
 - a. The activation of a smoke detector shall initiate an alarm verification operation whereby the panel resets the activated detector and waits for a second alarm activation. If, within an adjustable time delay, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm. If no second alarm occurs within the time delay, the system shall resume normal operation.

- b. The alarm verification shall operate only on smoke detector alarms. Other activated initiating devices shall be processed immediately. The alarm verification operation shall be selectable by device.
 - c. The panel shall have the capability to display the number of times a device has gone into a verification mode.
 - d. Detectors in alarm verification mode shall have the ability of being divided into seven different groups whereby any two activations from a group shall cause the panel to follow its programmed alarm sequence.
- H. The panel shall have four pass code controlled access levels. Pass codes shall be entered using the panel key pad.
 - 1. To maintain security when entering a pass code, the digits entered shall not be displayed.
 - 2. When a correct pass code is entered, an "ACCESS GRANTED" message shall be displayed. The access level shall be in effect until the keypad is inactive for 10 minutes or the operator logs out.
 - 3. Should an invalid code be entered, the operator shall be notified with a message and shall be allowed up to two more chances to enter a valid code. After three unsuccessful tries, an "ACCESS DENIED" message shall be displayed.
 - 4. Access to a level shall only allow the operator to perform actions within that level and actions of lower levels, not actions of higher levels.
 - 5. Access levels shall be associated with the following functions:
 - a. Alarm silence.
 - b. System reset.
 - c. Set time and date.
 - d. On/Off/Auto control selection.
 - e. Manual control.
 - f. Disable and enable circuits and devices.
 - g. Clear historical logs.
 - h. Walk test.
 - i. Change alarm verification.
 - j. Change detector sensitivity.
 - k. Function keys.

6. An access level shall also be associated with acknowledge keys. If the operator presses an Acknowledge key with insufficient access, an error message shall be displayed. The points on the log shall scroll with each key press, but the points shall not be acknowledged.
- F. The panel shall have the ability to store a minimum of 300 events in an alarm log plus a minimum of 300 events in a separate trouble log. These events shall be stored in a battery protected random access memory. Real time and date shall accompany history event recordings.
- G. The panel shall supervise subordinate module LED's for burnout or disarrangement. Should a problem occur, the panel shall display the module and LED location numbers to facilitate location of that LED.
- H. The panel shall have function keys programmed as follows for disabling and enabling circuits or groups of devices for maintenance or testing purposes. While circuits or devices are disabled, the panel shall indicate "TROUBLE".
 1. F1: Disable smoke detectors by floor.
 2. F2: Disable duct smoke detectors.
 3. F3: Disable sprinkler system flow switches.
 4. F4: Disable horns/strobes or speakers/strobes by floor.
- I. The system shall be capable of being walk tested by one person.
 1. The activation of an initiating device under test shall be silently logged as an alarm or supervisory condition in the historical log. The panel shall automatically reset itself after logging the abnormal condition.
 2. The momentary disconnection of an initiating device or notification appliance shall be silently logged as a trouble condition in the historical log. The panel shall automatically reset itself after logging the trouble condition.
 3. The walk test sequence shall have the ability to activate the notification appliances for a maximum of 2 seconds upon the activation of an initiating device under test. If this option is selected, any momentary opening of the initiating device circuit or a notification appliance circuit shall cause the notification appliances to sound for 4 seconds to indicate the trouble condition.
 4. Should the walk test mode be on for an inappropriate amount of time, the panel shall automatically revert to normal mode.
 5. Should an abnormal condition occur from an active point not in walk test mode, the system shall perform its standard programmed alarm, supervisory or trouble sequences.
- J. The panel enclosure shall be equipped with locks and transparent door panels providing freedom from tampering yet allowing full view of the various lights and controls.

2.3 NODE AND NAC PANELS

- A. Node and NAC panels shall be modular with solid state, microprocessor based electronics, operator interfaces, power supplies, audio generators, amplifiers, battery chargers and batteries as required. All components shall be supervised.

2.4 BATTERIES

- A. Batteries shall be lead calcium and supervised so that a failure produces a "TROUBLE" signal.

2.5 ADDRESSABLE SPOT DETECTOR BASES

- A. Spot detector mounting bases shall be individually addressable, suitable for Class A operation, with a twist-lock head locking feature a DIP switch or electronic addressing means, and an LED that provides power "on", alarm and trouble indications. The bases shall be listed for ceiling and wall mounting. Removal of the detector head shall cause a trouble condition at the panel.
- B. The bases shall include an auxiliary relay that is controlled from the panel.

2.6 PHOTOELECTRIC SMOKE DETECTOR HEADS

- A. Photoelectric type smoke detector heads shall include a pulsed LED light source and a silicon photodiode receiver, at least seven levels of sensitivity selectable at the panel, an integral insect screen and 360 degree smoke entry. This type of detector shall be installed in all duct detectors. .

2.7 HEAT DETECTOR HEADS

- A. Heat detector heads shall include combination rate-of-rise and rate compensated fixed temperature sensing, two levels of rate-of-rise sensitivity selectable at the panel, and an independent 135 degrees F fixed temperature set point. Heat detector heads shall be self restoring.

2.8 DUCT DETECTORS

- A. Duct detectors shall be individually addressable and consist of a housing, sampling tubes, a baffle and a detachable detector head. Duct detectors shall include an alarm LED, a local test switch, and an auxiliary SPDT relay for ventilation system control. Duct detectors shall be resettable by actuating the panel reset pushbutton. The sampling tubes shall be capable of being cleaned through the housing cover.
- B. The detector heads shall be photoelectric as specified above, but shall be capable of accepting ionization detector heads.
- C. When not in plain view, duct detectors shall include remote alarm indicators and test switches mounted in plain view at 48 inches above the floor.

2.9 MANUAL PULL STATIONS

- A. Manual pull stations shall be individually addressable, suitable for Class A operation, with a high impact red Lexan body and raised white lettering. Stations shall include an ADA compliant single action operating mechanism with a mechanical latch to hold an operated station open until reset.

- B. Reset shall be accomplished through use of a key common to the panel or a small flat-blade screwdriver. Stations which use allen wrenches or special tools to reset are not acceptable. The point of reset shall be front accessible so stations with tamper-resistant covers can be reset easily.

2.10 MONITOR MODULES

- A. Monitor modules for individual two wire contact monitoring shall be individually addressable, suitable for two wire operation, with a DIP switch or electronic addressing means, and a programmable latch feature for monitoring momentary contacts. Monitor modules shall monitor a single normally open dry contact using a Class B, Style B, initiating device circuit.
- B. Monitor modules for zone or four wire device monitoring shall be individually addressable, suitable for four wire operation utilizing 24 volt DC power from the panel, and with a DIP switch or electronic addressing means. Zone monitor modules shall monitor multiple normally open dry contacts using a Class B, Style B, two wire initiating device circuit, or monitor a four wire device using a Class B, Style D, four wire initiating device circuit.

2.11 CONTROL MODULES

- A. Control modules shall be individually addressable, with a DIP switch or electronic addressing means. Control modules shall provide a Form C contact rated .5 amps at 120 volts AC or 2 amps at 28 volts DC resistive that are controlled by the panel.

2.12 SPEAKERS

- A. Speakers shall be rated 125 to 12,000 Hertz, include four taps rated at from 1/4 to 2 watts, produce a sound level of 82 dBA at 10 feet when set at the 1/2 watt tap, and with a semi-flush body capable of wall or ceiling mounting.
- B. Speakers for locations with high ambient noise may be high efficiency horns rated 500 to 6,000 Hertz minimum, 10 watts minimum, include four or more taps, produce a sound level of 106 dBA minimum at 1 meter when set at the 1 watt tap, and be capable of wall or ceiling mounting.

2.13 STROBES

- A. Strobes shall be rated 15, 30, 60, 75, 110 or 177 candela for proper illuminance, with a 1 Hertz flash rate, Xenon flash, red body, clear Lexan lens with white "FIRE" or international fire symbol lettering, capable of being synchronized, and capable of wall or ceiling mounting.

2.14 COMBINATION SPEAKER/STROBES

- A. Combination speaker/strobes shall consist of the horns, speakers and strobes specified above, but combined on a single mounting plate. Combination units used outdoors and in wet areas shall be waterproof and mounted to waterproof back boxes.

2.15 EMERGENCY VOICE/ALARM COMMUNICATIONS

- A. Emergency voice/alarm communications shall include audio control modules for alarm tone and voice message generation, a minimum of six pushbuttons for selecting pre-recorded voice messages, controls to choose total building or selected areas communications, audio amplifiers, a local microphone, and remote microphones in remote annunciators and cabinets. All of the components except for the remote microphones shall be located in or adjacent to the fire alarm control panel.
- B. The audio control module default mode shall provide for automatic total building fire alarm evacuation. The audible evacuation alarm signal shall consist of three slow whoop alarm tones followed by a fire alarm voice evacuation message. At the end of each voice evacuation message, the alarm tones shall resume. The alarm tones and voice evacuation message shall sound alternately until the alarm acknowledge pushbutton at the fire alarm control panel or remote annunciator has been pressed. All audio signals and messages shall be digitally transmitted between nodes.
- C. The audio control modules shall provide for manual total building or selected area pre-recorded voice message generation by pushing a pre-recorded voice message pushbutton. One pushbutton shall initiate the fire alarm voice evacuation message, and the other pushbuttons shall initiate Owner-defined pre-recorded voice messages.
- D. The audio control modules shall provide for manual total building or selected areas communications. Upon keying of the microphone, two alarm tones shall sound over the speakers indicating a voice message will occur.
- E. The alarm tones shall be digitally generated by programmable software so that changes can be made without component rewiring. The voice messages shall be stored digitally in non-volatile EPROM memory.
- F. Audio amplifiers shall have a frequency response of 125 Hz to 12,000 Hz minimum.
- G. Microphones shall be of a hand-held, push-to-talk, noise-canceling type with a frequency range of 200 Hz to 4000 Hz and a self-winding five foot coiled cable. An LED shall indicate the microphone push-to-talk pushbutton has been pressed and the speaker circuits are ready for transmission.
- H. Remote microphones shall be enclosed in remote annunciator cabinets or wall-mounted cabinets as shown on the plan drawings, with the same pushbuttons for selecting pre-recorded voice messages, and lockable doors. Remote microphones shall duplicate the manual voice transmission capability of the local microphone at the fire alarm control panel. The fire alarm control panel microphone shall have priority over any remote microphones.
 - 1. The remote microphone in a remote annunciator cabinet shall provide for total building or selected areas communications.
 - 2. The remote microphone and cabinet at the fire alarm system head end equipment in the Office of Public Safety shall provide for total building or selected areas communications.

2.16 FIREFIGHTER'S TWO-WAY TELEPHONE COMMUNICATION SERVICE

- A. Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:
 - 1. Common-talk type for firefighter use only.
 - 2. Selective-talk type for use by firefighters and fire wardens.
 - 3. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously.
 - 4. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes audible signal to sound and high-intensity lamp to flash.
 - 5. Selector panel controls shall provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
 - 6. Display: Liquid-crystal digital to indicate location of caller.
 - 7. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved "Fire Emergency Phone."
 - 8. Handsets: Push-to-talk-type sets with noise-canceling microphone stored in a cabinet adjacent to fire-alarm control unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide wiring in conduit in accordance with Sections 260500 and 260519, and Manufacturer's instructions.
- B. All cabling systems used for fire alarm system wiring pathways shall be two-hour fire rated per 2010 NFPA Article 12.4.3 requirements regarding Level 2 Pathway Survivability.
- C. Circuits shall not be T-tapped.
- D. Provide waterproof back boxes with gaskets for devices and appliances installed outdoors or in wet or wash-down areas.
- E. Paint fire alarm junction boxes, covers and fittings red except fire alarm raceways exposed in finished areas may be painted to match wall color.
- F. Final connections to the fire alarm system components and system programming shall be performed by Fire Alarm Technicians with NICET Level II or higher certification.
- G. Label fire alarm panels with the room numbers, electrical panel numbers and circuit breaker numbers feeding them.
- H. Paint circuit breakers feeding fire alarm panels "red", and install handle locks.

- I. Duct type detectors shall not be installed in the ducts until after the ducts have been cleaned and the duct filters have been changed.
- J. Ceiling mounted detectors shall either not be installed prior to completion of other construction work in the area, or plastic covers shall protect the detectors until the other construction work is completed.
- K. Fire alarm system shall be connected, programmed, tested and certified, by NICET certified fire alarm persons. Raceway, wiring and installation shall be by licensed electricians. The fire alarm contractor shall provide the University, on CD, a complete "Windows System" compatible copy of the operational and application programs. This electronic documentation will reflect the system as configured after the certification testing is completed and accepted.

3.2 TESTING

- A. Demonstrate complete operation of the fire alarm system in accordance with NFPA 72, NFPA 101, the Michigan Building Code, and Manufacturer's instructions. Notify the Owner's Representative 7 working days in advance of the test.
 - 1. The test shall be witnessed by WSU ORM, a WSU Electrical Inspector, and the WSU Fire Protection Shop.
- B. Submit a signed and dated NFPA 72 test report to the Electrical Inspector and Authority Having Jurisdiction prior to acceptance of the fire alarm system by the Owner.

END OF SECTION 283111

SECTION 331100 – WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes listing materials for the construction of distribution water mains.
- B. Related Requirements:
 - 1. Gate Valve / Gatewells - 33-12-17.
 - 2. Distribution Hydrants - 33-12-16.
 - 3. Water Services - 33-12-13.
 - 4. Commissioning Water Distribution Systems - 33-07-10.

1.02 REFERENCES

- A. Standards:
 - 1. ANSI – American National Standards Institute.
 - 2. AWWA – American Water Works Association.
- B. Reference Standards:
 - 1. MDOT Michigan Department of Transportation – “Standard Specifications for Construction”.
 - 2. ASTM American Society of Testing Material – “Specific Volume/Article”.
 - 3. NSF 61 – ANSI/NSF Standard 61 – “Drinking Water System Components”.

1.03 ACTION SUBMITTAL

- A. Product Data: Submit data sheets for all water main materials.

PART 2 - PRODUCTS

2.01 MATERIALS

All pipe and fittings shall have the pipe class material type and date of manufacturer clearly marked on each piece.

- A. Ductile Iron Pipe:
 - 1. Ductile Iron Pipe shall conform to AWWA C151/ANSI Specifications A21.50 and A21.51.
 - a. Pipe wall class shall be: Class 54 for watermain pipe 6” through 16”.
 - b. Ductile iron pipe shall be double lined with bituminous seal coated cement mortar with tapered ends. The cement mortar lining and seal coat shall conform to the requirements of the AWWA C104/ANSI Specification A21.4.
 - c. Joints shall be “push-on” type to conform to the latest revision of the ANSI Specifications A20.10 and A21.11.
 - 2. Ductile Iron Fittings:
 - a. The ductile iron fittings shall meet all the requirements of ANSI Specification A21.10, 125 psi for pressure piping.
 - b. Mechanical joints shall conform to ANSI Specification A21.11. (hydrant tees only)
 - c. Bolts shall be “Cor-Blue”.
- B. Restrained Joints (when noted in the drawings):
 - 1. Mechanical Joint Restraint (RJ) shall be ductile iron for use with mechanical joints conforming to ANSI Specifications A21.11 and A21.53. Device shall have rated working pressure of 250 psi. Supplier: EBBA Iron Inc. “Megalug Series 1100.
 - 2. Locking gaskets (RJ) shall be Lock-tyte.

- C. Polyvinyl chloride Pipe:
 - 1. PVC pipe shall conform to AWWA C900.
 - a. Pipe wall class shall be class 200, PR-14.
 - b. Joints shall be "pushon" type.
- D. Couplings for "cut-in" assemblies shall be:
 - 1. Cascade waterworks style CDC; or
 - 2. Romac Industries style 501.
- E. HDPE Pipe.

3.02 MIXES

- A. Pipe Bedding: Bedding material shall be:
 - 1. Granular Class 2; or
 - 2. Stone.
- B. Masonry Materials:
 - 1. Concrete block shall be solid pre-cast conforming to ASTM C 139.
 - 2. Concrete brick shall conform to ASTM C-55, Grade S-11.
 - 3. Concrete shall be:
 - a. Transit mixed concrete 3000 psi 5 sk
 - b. Field mixed:
 - 1) Portland cement ASTM C-150 I; Masonry sand, 2MS; and Stone Aggregate ¾" to 1" max.
 - 2) Proportions 1:2:4.
 - 4. Piling may be steel I beam or 8" / 6" Ductile Iron Pipe.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Minimum cover over mains shall be 6 feet or as required by the local municipality including crossings through ditch sections. When mains parallel ditches, they shall have 6 feet of cover below the ditch shoulder, to insure cover for house service.
- B. The location of the piping as shown on the Plans, has been determined to avoid, insofar as possible, interference with structures or fixtures aboveground and other underground mains, services, utilities, or structures.
 - 1. Whenever it is necessary to deflect pipe from a straight line, either in the horizontal or vertical planes, to avoid obstructions or where long radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory jointing and shall be approved by the Engineer. In no case shall deflection of joints exceed the manufacturer's recommended maximum deflection.
- C. Thrust Block: Thrust blocks for watermain shall be sized as follows: Area in square feet of concrete thrusting against undisturbed earth shall be computed by dividing the total thrust by the safe bearing load of the soil.
Bearing Area is determined;.... Thrust[table a] / soil bearing[tableb] = sq. ft.of bearing area

Thrust[table a]

<u>Main Size</u>	<u>Tee-Dead-End</u>	<u>90° Bend</u>	<u>45° Bend</u>	<u>22-1/2° Bend</u>
6"	4,250 lbs.	6,000 lbs.	3,250 lbs.	1,660 lbs.
8"	7,540	10,670	5,770	2,940
12"	16,970	23,990	12,980	6,620
16"	30,160	42,650	23,090	11,770
20"	47,120	66,650	36,070	18,390
24"	67,860	96,000	51,940	26,480

36"	152,680	215,920	116,860	59,580
b.	Safe bearing load (pounds per sq. ft.) psf.			
	<u>Soil Type</u>		<u>lbs. per sq. ft.</u>	
	Muck, Peat, etc.		0	
	Soft Clay		1000	
	Sand		2000	
	Sand and Gravel		3000	
	Sand and Gravel cemented with clay		4000	
	Hard Compact Clay		5000	

3.02 INSTALLATION

A. Placement:

1. Proper and suitable tools and appliances for the safe and careful handling, conveying and laying of the pipe shall be used. Care shall be taken to prevent the coating of cast iron pipe from being damaged. Pipe, valves, hydrants and fittings strung along the route shall be placed in such a manner that they will not be submerged or collect water.
2. All pipes shall be laid true to the required lines and grades. All trenches when pipe laying is in progress shall be kept dry; and all pipes and specials shall be uniformly supported on a properly trimmed excavation with holes at each joint to receive bells.

B. Construction:

1. All excavation and backfill above pipes shall conform to specifications. Pipes shall be laid on a compacted sand bedding 4 inches thick, and around and above the main to a height of 12 inches with sand. Sand shall be compacted in 6-inch lifts and to 95% density. The subgrade upon which the pipe is placed shall consist of material suitable for supporting the pipe without excessive settlement or stress development.
2. All cutting of the pipe shall be done in a neat workmanlike manner with the least amount of waste and without damage to existing or new lines. A fine tooth saw, tubing or pipe cutter, or similar tool shall be used to cut the pipe. Cut must be square and ragged edges removed with a cutting tool and/or file.
3. Thrust blocks shall be placed at all 22-1/2, 45, 90° bends, tees, and dead ends; crosses as required.
 - a. Thrust block size shall be determined:
 - 1) As shown on the drawings and;
 - 2) Providing a soil contract area determined as noted in Article 3.01C1, above.
 - b. In muck or peat, all thrust shall be resisted by pilings driven to solid foundations or by removal of muck or peat and replacement with ballast of sufficient stability to resist thrusts. In all cases, thrust block size and method of thrusting must be approved by the Engineer before the thrust block is poured.
4. At the termination of pipe laying any open ends of pipelines shall be closed off by a suitable cover until laying operations are resumed.

3.03 START-UP

- #### A.
- Distribution Water piping and appurtenances shall be pressure tested and chlorinated as specified in "Commissioning Water Distribution Systems Section 33-07-10".

END OF SECTION

SECTION 311413 – STRIPPING & STOCKPILING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirement for "Stripping and Stockpiling".
- B. Topsoil shall become the property of the Contractor except for quantities used for site replacement topsoil. Excess topsoil shall be removed at completion of the project.
- C. Excavated Material I shall become the property of the Contractor except for quantities used for site backfill
I. Excess Excavated Material shall be removed at completion of the project

1.02 QUALITY ASSURANCE

- A. Retain land surveyor to establish specific contract location and elevations for site grading.
 - 1. Subgrade and finish grade locations shall be established.

PART 2 – PRODUCTS – NONE

PART 3 – EXECUTION

3.01 PREPARATION

- A. Establish stockpile limits:
 - 1. Review limits of work and drainage structure.
- B. Before removing topsoil, reduce all vegetation to a height of approximately 6 inches. Remove and dispose of all cut vegetation, brush, rocks, and other litter.

3.02 STRIPPING AND STOCKPILING

- A. Removing:
 - 1. Remove topsoil to the required depth from designated areas before excavating or placing embankment. Use equipment and methods that avoid lifting subsoil. Suspend topsoil removal if soil or weather conditions are unsuitable.
 - 2. Remove topsoil within the grading limits.
 - 3. Screen topsoil to remove roots, shredded brush rock, vegetation greater than ½" in size.
- B. Stockpiling:
 - 1. Locate and shape stockpiles outside of the drip line of preserved trees. Locate topsoil stockpiles away from drainage courses and wetlands.
 - 2. Stockpile topsoil from the roadway within the right-of-way and outside the limits of construction or use in the slopes.
 - 3. After removal of the stockpiles:
 - a. Grade the site.
 - b. Seed and mulch.

END OF SECTION

SECTION 312216 – SITE EXCAVATING & GRADING

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes requirement for site excavation and site grading to prepare earth subgrade for topsoil and/or aggregate subsequent placement.
- B. Excavated materials shall become the property of the Contractor except for quantities approved for use as acceptable backfill.

1.02 REFERENCES

- A. Reference Standards:
 - 1. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft (T-99).

1.03 QUALITY ASSURANCE

- A. Retain land surveyor to establish specific contract location and elevations for site grading.
 - 1. Subgrade and finish grade locations shall be established.

PART 2 – PRODUCTS – NONE

PART 3 – EXECUTION

3.01 PREPARATION

- A. Establish cut and fill grades:
 - 1. Review limits of work and drainage structure.

3.02 GRADING

- A. GENERAL
 - 1. Grade all areas within contract limits outside building, structures and hard surface improvements (such as paving, concrete slabs and the like).
 - 2. Perform all necessary earth moving, dozing and grading of soil material to provide a surface within the specified tolerances, free of voids and soft spots.
 - 3. Provide uniform levels or slopes between given points or between such points and existing grades.
 - 4. Provide grading for positive drainage and erosion control.
 - 5. Hand grade areas adjacent to exterior of building and structures to drain away from the structure and to prevent ponding of water.
- B. Earth Excavation:
 - 1. Compact the subgrade to not less than 95 percent of Standard Proctor to a depth of at least 10 inches. If the subgrade cannot be compacted to 95 percent of Standard Proctor, using conventional construction methods, the Engineer may authorize use of other methods to attain compaction.
 - 2. Maintain the roadbed and ditches and keep well drained at all times. Installing and removing temporary drainage facilities will be at the Contractor's expense.
 - 3. Conduct grading to avoid removing or loosening material outside the required slopes. If material is removed, or loosened outside the required slopes, replace and compact to the required density and cross section.

- C. Machine Grading: Machine grading consists of grading for an approximate depth of 12 inches. This work Includes scarifying, plowing, disking, moving, compacting, and shaping the earth to develop the cross section shown on the plans. Grade ditches to drain runoff waters. Grade all intersections, approaches, entrances, and driveways as shown.
1. Grade to subgrade elevation of $\frac{3}{4}$ inch (0.05 ft) \pm .
- D. Trimming and Finishing Earth Grade: (Topsoiling and Pathways)
1. Construct the earth grade to the required grade and remove all exposed stones and rocks more than 3 inches in diameter.
2. Where trees or other restrictions do not interfere, round the tops of backslopes, bottoms of fill slopes and all other angles in the lines of the cross section to form vertical curves as shown on the plans or as directed.

END OF SECTION

SECTION 312316 – STRUCTURAL EXCAVATION BACKFILL & COMPACTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included in this Section: Perform structural excavation, backfill and compaction indicated on the Drawings or specified herein.
- B. Related Requirements:
 - 1. Testing Laboratory Services: Section 01-45-23
 - 2. Submittals: Section 01-33-00.
 - 3. Common Material for Earthwork: Section 31-05-10.

1.02 REFERENCE

- A. Reference Standards:
 - 1. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf /ft (T-99).
 - 2. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56000) ft-lbf/ft (T-180).

1.03 INFORMATION SUBMITTALS

- A. Source of Materials: Submit the source of borrow and granular materials proposed for the work, giving location, and as applicable, name and address of supplier.

1.04 QUALITY ASSURANCE

- A. Quality Control: The testing laboratory services provided under Section 01400 will perform the following:
 - 1. Field Density Tests:
 - a. Determine by nuclear methods (ASTM D2922).
 - b. Make field density tests or compacted sub grade soils on basis of 3 tests plus one additional test per 10,000 sq. ft. area or fraction thereof.
 - c. Make 3 field density tests of each lift of compacted fill or backfill placed each day.

PART 2 – PRODUCTS

2.01 MATERIAL

- A. Materials shall be listed in Section 31-05-00 Common Materials for Earthwork.
 - 1. Aggregate 6A or 3G.
 - 2. Granular Material – Class II.
 - 3. Excavated Material – Acceptable.

PART 3 – EXECUTION

3.01 METHODS OF OPERATION

- A. Determine the method of operation for this work and be solely responsible for the effect of same and for soil movements, or disturbance, which may take place, and for all damages to structures, construction, or other operation. Side slopes and sheeting shall be such as the Contractor may elect after due consideration of soil stability, conditions to be encountered, or codes.

3.02 EXCAVATION

A. General:

1. Excavation shall include removal, hauling and disposal of all classes of materials and obstructions encountered for work specified.
2. Perform excavations with sufficient space to permit placing and removal of concrete formwork and bracing, installation of other work shown, and inspection.
3. Excavation for footings may be accurately made to the lines of footings where nature of soil will permit, or to the limits indicated on the Drawings; otherwise allow for forms.
 - a. In excavation for footings and foundations, take care not to disturb bottom of excavation.
 - b. Trim, level and clean excavation bottoms just prior to placing concrete.
4. No concrete for foundation work shall be placed until soil bearing capacity has been verified and the soil conditions have been approved.

B. Shoring and Bracing: Provide and maintain shoring, bracing, sheet piling, and other temporary work as required to contain banks of excavation, or to support existing construction during fill or backfill placement and compaction. Remove such shoring and bracing when no longer required, except as otherwise approved.

C. Removal of Unsatisfactory Soil Materials: Remove all unsatisfactory soil materials encountered at bearing elevations. Fill the space under footings and foundations with backfill and compact backfill materials as specified hereinafter for excavations of the same classification.

D. Unauthorized Excavating: If excavations are carried below the indicated level without being so directed, or unsatisfactory conditions caused by the Contractor's operations require extra excavation, the Contractor shall fill these areas with flowable fill at his own expense.

E. Storage of Satisfactory Excavated Materials: Stockpile excavated material classified as "Excavated Material – Acceptable" on the project site until required for fill, backfill, or rough grading. Place, grade, and shape stockpiles for proper drainage.

F. Disposal of Waste Excavated Materials: Promptly remove as the work progresses all waste materials resulting from excavating operations and remove excess satisfactory excavated material, and legally dispose of off the Owner's premises.

3.03 PROOF ROLLING – NONE

3.04 FILLING AND BACKFILLING

A. Preparation Prior to Filling or Backfilling:

1. Fill and backfill excavations promptly as the work permits, but not until the following:
 - a. Approval of construction below finish grade.
 - b. Inspection, testing, approval, and recording location of underground utilities.
 - c. Removal of concrete formwork.
 - d. Removal of shoring and bracing.
 - e. Removal of trash and debris.

B. Placing Fill and Backfill Materials:

1. Schedule filling and backfilling to expedite construction progress and to maintain positive site drainage.
2. Backfill after foundation walls have been completed and have attained proper strength.
3. Backfill in manner to prevent excessive pressure against work-in-place.
4. Place fill and backfill material in uniform layers of thickness commensurate with the soil material and compacting equipment used. Compact in true planes at correct elevations.

C. Compaction:

1. Compact soil material with equipment suitable for the soil material being compacted and the location of the work relative to other construction and capable of obtaining the required percentage maximum density throughout the entire layer of soil material.

2. Prior to compacting soil material having a well-defined moisture-density relationship, increase or reduce the moisture content of the soil material as determined by the applicable Proctor Test within limits of plus or minus 3 percentage points.
 3. Do not flood soil material in place.
 4. Suspend compaction operations when weather conditions or other unsatisfactory conditions make it impossible to obtain satisfactory results.
- D. Fill and Backfill and Percentage Maximum Density Requirements:
1. Under Foundations: Fill or backfill under concrete foundations for building from surface to underside of foundation with Granular Material, place in 12 maximum layers, and compact to Modified Proctor Test 95% maximum density.
 2. Within Building Walls: Backfill excavations within building walls with Granular Material to underside of fill under concrete floor slab-on-ground, place in 12" maximum layers, and to compact to Modified Proctor Test 95% maximum density.
 3. Floor Slab-on-Ground: Fill under concrete floor-slab-on-ground within building walls from surface of subgrade or backfill, as applicable, to underside of concrete floor slab-on-ground with Granular Material, place in 12" maximum layers, and compact to Modified Proctor Test 95% maximum density.
 4. Outside Building under Paving Areas: Backfill excavations outside building under areas to receive bituminous or Portland cement concrete paving with Granular Material to underside of paving base course, place in 12" to 18" maximum layers, compact to Standard Proctor Test 95% maximum density.
 5. Outside Building Under Lawn Areas: Backfill excavations outside building area with material placed in 18" to 24" layers, and compact to Standard Proctor Test 80%.

3.05 GRADING

- A. General: Grade backfill and fill materials placed under this Section to provide a smooth surface within the specified tolerances, free of voids and soft spots, and compacted.
- B. Areas within Building Walls: Shape surface of fill or backfill within building walls to line and grade to within plus-or-minus ½" of subgrade elevation indicated for underside of concrete floor slab-on-ground when tested within a 10-foot straight-edge applied both parallel to, and at right angles to the walls enclosed the area.
- C. Areas Adjacent to Exterior of Structures: Hand grade areas adjacent to exterior building walls and other structures to drain away from the building or structure and to prevent ponding of water.

3.06 CLEANING

- A. Make every effort to keep streets, roads and drives free from waste material resulting from earthwork operations. Clean such surfaces as required, or when directed, to eliminate any waste material deposited.

END OF SECTION

SECTION – 312333 TRENCHING BACKFILL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes requirements and materials for excavating and backfilling of utility pipeline, sewer, water main and appurtenances and placement.
 - 1. Special foundation [trench stabilization] at the trench bottom below the pipe bedding, if shown on the drawings, is specified elsewhere.
- B. Related Requirements:
 - 1. Common Materials for Earthwork 31-05-10.
 - 2. Utility Division 33-00-nn.

1.02 REFERENCES

- A. Definitions
 - 1. Backfill is the specified material to be placed in the excavation for the facility.
 - 2. Pipe Bedding is the material below and around/above the piping installed as shown on the drawings and as specified for the respective pipe being constructed
 - 3. Pipe Foundation.
 - 4. Paved surfaces.
- B. Reference Standards:
 - 1. American Society Testing Material – ASTM.
 - 2. American Association of State Highway and Transportation Officials – AASHTO.
 - 3. Michigan Department of Transportation – MDOT.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Notification to “MISS DIG” utility marking agencies.
 - 2. Notification to Owner regarding excavation.

1.04 ACTION SUBMITTALS

- A. Product Data:
 - 1. Source of Materials: Submit source of borrow material, aggregates and granular material proposed for the work, giving location, and as applicable, name and address of supplier.
 - 2. Test Reports: When excavated material is proposed for backfilling under paving, driveway surfacing and adjacent area, submit test reports, performed by an independent laboratory testing service approved by the Engineer, indicating the proposed backfill material's conformance with the requirements specified excavated material acceptable.

1.05 SITE CONDITIONS

- A. Existing Conditions:
 - 1. Surface and Underground Hydrology:
 - a. The Contractor shall determine to what extent, if any, variations in surface water levels and underground water levels may affect the work under this Contract.
 - b. All work shall be performed in the dry and that means and methods shall be employed by the Contractor to protect the work as necessary at no additional cost to the Owner.

2. Dewatering:
 - a. Where the work is in ground containing an excessive amount of water, the Contractor shall provide, install and maintain an adequate dewatering system in order to permit under relatively dry conditions the performance of excavation, construction of the pipelines and related work, and placement of backfill.
 - b. Dewatering outlets shall be approved by the Engineer.
 3. Pumping, Maintaining Sewage Flow and Trench Drainage:
 - a. Adequate pumping and drainage facilities shall be provided and all water from whatever sources entering the work during any stage of construction shall be promptly removed and disposed of. All pumping and drainage shall be done without damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic, or the work of other Contractors. Dewatering shall be done in such a manner that the soil under or adjacent to existing structures shall not be disturbed, removed or replaced.
 - b. Both the dry weather and storm flows in all existing sewers ditches, streams, rivers and drains, which may in any way be affected by the new construction, shall be adequately maintained.
 - c. All gutters, ditches, catch basins, and other surface water inlets and drains shall be kept clear for proper surface drainage.
- B. Protection: Provide and maintain barricades, warning signs, warning lights and other protection required by applicable laws, regulations and safety codes for safety of persons and protection of property during earthwork operations.

PART 2 – PRODUCTS

2.01 MATERIALS (Section 31-05-10)

- A. Foundation: 3 x 1, 32G or 6A Aggregate.
- B. Pipe Bedding Encasement: 34R [pea stone] or granular CLII.
- C. Backfill:
 1. Class II Granular or “Acceptable Excavated Material” shall be used for all trench locations under adjacent to existing and proposed paved surfaces., sidewalks
 - a. Additionally, above materials shall be used when a portion of the trench is within the 1 on 1 slope line influences of paved surfaces.
 2. Excavated material meeting the following requirements may be used areas excluding paved surfaces and building foundations.
 - a. Material shall be free from particles exceeding 3” in largest dimension, lumps of fine-grained soils, cinders, ashes, refuse, debris, topsoil, organic matter, and other deleterious materials and capable of being compacted to the required percentage maximum density by the compacting equipment to be used.
 3. Flowable fill shall be used for trenches under proposed or existing building foundation and other transverse pipeline line crossings.

2.02 QUALITY CONTROL

- A. Field:
 1. Compact soil materials by compacting equipment suitable for the soil material being compacting and the location of the work and capable of obtaining the required percentage maximum density throughout the entire layer of soil material.

2. Prior to compacting soil material having a well-defined moisture-density relationship, increase or reduce the moisture content of the soil material as determined by the applicable Proctor Test within limits of plus or minus 3 percentage points.
3. Suspend compaction operations when weather conditions or other unsatisfactory conditions make it impossible to obtain satisfactory results.

B. Compaction Testing:

1. Compact soil material to the required percentage maximum density as determined by the Standard Proctor Test (ASTM D698/AASHTO T-99), as specified, for soil materials having a well-defined moisture-density relationship curve.

PART 3 – EXECUTION

3.01 PREPARATION

A. Pavement Removal:

1. Removal shall be per RCOC Standards. Remove pavement to a minimum width of 6' and at least 1' wider than excavation.
 - a. Where Portland cement concrete is to be removed, the remaining slab width from the patch to an existing joint shall be a minimum of 5'. Cut concrete pavement by sawing to a minimum depth of 5".
 - b. Where bituminous concrete pavement, cut pavement by sawing, unless otherwise approved by the Engineer.
 - c. If repair area is less than 4'-0" from joint then remove to joint.
 - d. 18" #6 epoxy-coated rebar at 1'-0" for all concrete pavement joints.
2. Make all saw cuts in a straight line and parallel to existing transverse and longitudinal joints, unless otherwise approved by the Engineer.

B. Shoring and Bracing:

1. Provide and maintain shoring, bracing, sheet piling and other temporary work as may be necessary for the safety and protection of the work, public or adjacent property.
2. Remove such shoring and bracing when no longer required, unless otherwise approved by the Engineer. Fill voids left by removal of shoring and bracing with sand, compacted in place.
3. Left in Place Shoring and Bracing:
 - a. Leave in place shoring and bracing indicated on the Drawings or specified to be left in place, or directed by the Engineer.
 - b. Cut off all shoring and bracing left-in-place at least 5' below final grade.
 - c. Whenever the Engineering, in writing, orders bracing to be left in place, such shoring and bracing will be paid for by the Owner.
 - d. Shoring and bracing left in place by the Contractor shall be at no cost to the Owner.

3.02 EXCAVATION

A. Trench Excavation:

1. Begin trench excavation at the outlet and proceed toward the upper end.
2. Excavate trench so that the conduit can be laid to the alignment and grade indicated on the Drawings.
3. Excavate trench bottoms below the pipe invert a sufficient distance to provide space for the pipe bedding as specified under the Specifications Section covering the kind of piped utility system.

4. Maximum width of trench at top of pipe shall be as follows:

Pipe Outside Diameter (O.D.) Trench Width

Up to 12"	30"
15" through 30"	Pipe O.D. plus 18"
36" and larger	Pipe O.D. plus 24"

- a. If maximum trench width specified, above, is exceeded, construct a type of approved bedding to provide support for the additional load.
 - b. When sand, or coarse aggregate, or coarse aggregate-sand bedding material is to be used, maintain the maximum trench widths to permit compaction of the bedding material around the pipe.
 - c. When pearrock or angular stone bedding material is to be used, provide a minimum of 6" clearance on each side of the pipe.
5. Depth of trench over water lines shall provide a minimum cover over top of pipe of 5'.
6. Remove ledge rock, particles over 2" in least dimension and other obstructions to provide a minimum clearance of 6" at bottom and sides of pipe.

B. Excavation for Utility Appurtenances:

1. Perform excavations with sufficient space to permit placing of precast concrete sections, placing and removal of concrete formwork (if any) installation of other work, and for inspection.
2. Excavation for cast-in-place concrete foundations shall be made to the foundation lines where the nature of soil will permit; otherwise allow for concrete forms.

C. Removal of Unstable Soil Materials:

1. Remove all unstable soil materials encountered at bottom elevation of excavations.
2. Fill excavations for unstable soil materials to elevation of bottom of excavations with "Foundation aggregates" and compact.
3. The cost of such excavation, filling, and disposal of unstable soil materials to 12" below bottom of the proposed pipe bedding shall be paid for by the Contractor.
4. Such excavating, filling, and disposal of unstable soil materials in excess of 18" below bottom of the proposed pipe bedding will be paid for by the Owner.
5. Where unstable soil materials below bottom elevation of excavations is unstable to such a degree that it cannot be removed and replaced with "Foundation Aggregate" as specified in this Paragraph, the Contractor shall cease work and notify the Engineer.

- D. Unauthorized Excavation: If excavations are carried below the required bottom elevations without being so directed by the Engineer, or unstable soil conditions caused by the Contractor's operations require extra excavation, fill such excavations and backfilling will be at no cost to the Owner.

3.03 EXCAVATED MATERIAL

A. Storage of Excavated Material:

1. Stockpile excavated material classified as "Acceptable Excavated Material" as may be required, in an orderly manner a sufficient distance from the banks of excavations to avoid over-loading and to prevent slides or cave-ins.
2. Pile such excavated material on side of excavations to permit ready access to and use of existing fire hydrants, shut-off valves, and other utility services and not to obstruct surface drainage of adjacent areas.

- B. Disposal of Waste and Excavated Materials: Promptly remove, as the work progresses, all waste materials resulting from excavation operations and remove excess excavated material classified as Class A or B Trench Backfill Material, and legally dispose of off the Owner's premises.

3.04 BACKFILLING:

A. General:

1. Backfill trench excavations from top of pipe bedding encasement with materials as specified under Paragraph 2.01.C. to finish grades, unless otherwise specified.
2. Backfill excavations for utility appurtenances using granular CLII from bottom of foundation elevation to finish grade, unless otherwise specified.
3. Backfilling shall follow no further than 100' behind pipe laying.

B. Preparation Prior to Backfilling:

1. Backfill excavations promptly as the work permits, but not until the following:
 - a. Approval of construction below finish grade.
 - b. Inspection, testing, approval and recording location of underground utilities.
 - c. Removal of concrete formwork.
 - d. Removal of shoring and bracing or cutting off shoring and bracing to be left in place, as applicable.
 - e. Removal of trash and debris.

C. Placing Backfill Materials:

1. Schedule backfilling to expedite construction progress and to maintain positive site drainage.
2. Backfill after cast-in-place concrete or masonry construction, or both, has attained proper strength.
3. Place backfill material in uniform layers of thickness not exceeding one (1ft). commensurate with the soil material and compacting equipment used.

D. Backfilling Under Paving, Surfacing and Adjacent Areas:

1. Backfill trench excavations with place in maximum layers, compact to Standard Proctor Test 95% maximum density.
2. Backfill utility appurtenances excavations within 3' of utility appurtenance (such as manholes and the like) with granular CLII , place in 12" maximum layers, compact to 95% maximum density.
3. Except under walks or where noted, bring backfill up to 10-1/2" below original paving surface. See detail.
4. Under walks, bring backfill up to 2" below original walk grade.

E. Backfilling Under Areas Outside of Sidewalk, Paving and Under Grassed Areas:

1. Backfill trench excavations with Class B Trench Backfill Material, place in 18" maximum layers, compact to approximately same density as adjacent soil-in-place but not less than 95% maximum density.
2. Backfill utility appurtenance excavations within 3' of utility appurtenance with Sand or Class 2 Granular Material, place in 12" maximum layers, compact to approximately same density as adjacent soil-in-place but not less than Relative Density Test 55% maximum density or Standard Proctor Test 70% maximum density.
3. Mound backfill material to allow for settlement and later grading to conform to original levels and appearance.

F. Backfilling in Freezing Weather: No frozen material shall be buried more than 4' below the final elevation of ground.

END OF SECTION

SECTION 321921 – CONCRETE SIDEWALK

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes material requirement for and the construction of concrete sidewalks of type and size as shown on the drawings.
- B. Related Requirements:
 - 1. Common Base and Surfacing Aggregates 32-05-13.
 - 2. Concrete for Paving 32-05-23
 - 3. Tactile Warning surfaces 32-17-26
 - 4. Paving and Surface Restoration 32-01-10.
 - 5. Common Materials for Bases and Paving 32-05-16.
 - 6. Typical Cross Sections 32-99-16

1.02 REFERENCES

- A. Standards:
 - 1. ASTM: American Society of Testing Materials
 - 2. MDOT: Michigan Department of Transportation 'Standard Specifications for Construction'
 - 3. MDOT, Standard Details as noted.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Co-ordination: Schedule sidewalk placement to eliminate impacts on community activities and mitigate possible damages to the newly constructed sidewalk.

1.04 ACTION SUBMITTALS

- A. Product Data:
 - 1. Submit data for joint material and curing compound.
 - 2. Submit design mix data for the proposed concrete mixes.

1.05 SITE CONDITIONS

- A. Environmental Requirements:
 - 1. Placing Temperature: When the temperature of the surrounding air is expected to be below 40° F during concrete placing or within 24 hours thereafter, or when the temperature of the concrete exceeds 90° F, precautionary measures approved by the Engineer shall be put into effect.
 - a. When the temperature of the steel forms is greater than 120° F the steel surfaces shall be sprayed with water just prior to placing the concrete.
 - 2. Freshly placed concrete shall be protected as required to maintain the temperature of the concrete of not less than 50° F nor more than 80° F and in a moist condition continuously for the period of time necessary for the hydration of the cement and proper hardening of the concrete.
 - a. Changes in temperature of the concrete during curing shall be as uniform as possible and shall not exceed 5° F in any one hour nor 50° F in any 24 hour period.
- B. Protection of Subgrade:
 - 1. Maintain subgrade in a smooth and compacted condition until concrete has been placed.
 - 2. When mean daily temperature is less than 35EF, protect the subgrade from freezing by covering it with dry granular insulation material of sufficient depth to prevent frost penetration, as approved by the Engineer.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Form Materials:
 - 1. Wood or steel forms, of sufficient strength to resist springing during concrete placing operation.
 - 2. Straight and free of warp. A form which varies from a straight line more than 1/8" in 10 feet in either vertical or horizontal direction will not be permitted.
 - 3. Wood forms shall be No. 2 Common or better lumber, dressed on one side, not less than 3" nominal thickness, and of width equal to not less than full depth of concrete at edge.
 - 4. Steel forms shall be shaped steel sections, of depth equal to not less than full depth of concrete at edge, and free from warps, bends, and kinks.
- B. Bituminous Expansion Joint Fillers: ASTM D994 preformed bituminous type; size shown on the drawing details; such as W.R. Grace & Co. "Servicised Code 1301", W.R. Meadows Inc. "Asphalt Expansion Joint", Celotex Corp. "Elastite", or approved equal.
- C. Membrane Curing Compound shall be one of the following
 - 1. White Pigmented: ASTM C309, Type 2 white pigmented type, such as W.R. Grace & Co., "Code 2803-A", W.R. Meadows Inc., "WP-40" or approved substitute.
 - 2. Transparent: ASTM C309, Type I-D, Class B, fugitive dye type, such as
- D. Granular Material: Granular Material Class II.....
- E. Reinforcing Steel: (shown on the drawings)
 - 1. Fabric for sidewalk shall conform to: ASTM A185 "Steel Welded Wire".
 - 2. Fabric supports shall be:
 - a. Furnished for a support height of three (3") inches.
 - b. Wire slab bolsters with plate or ASTM A 185 "Steel Welded Wire".
 - c. Plastic supports fabricated for wire mesh support.
 - 3. "Epoxy Coating" where noted on the drawings: Mesh shall be epoxy coated in accordance with ASTM D 3959.

2.02 MIXES

- A. Concrete shall be 3.0A [5 sk mix] or as noted on the drawings.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Subbase:
 - 1. Subgrade Preparation:
 - a. Remove all unstable subgrade material, replace with granular material, and thoroughly compact.
 - b. Where tree roots interfere, carefully trim and cut roots to allow proper construction of walk, but not to cause any permanent damage to trees.
 - c. Thoroughly compact subgrade before placement of base or concrete, as applicable.
 - 2. Base for Walks:
 - a. Base shall be a minimum of 4" thickness of compacted granular material Class II.
 - b. Where the existing subgrade, is granular material, a Class II base will not be required.
- B. Placing Forms:
 - 1. Form Grade/Elevation: Form shall be set to provide the following grades/slopes.
 - a. Cross Slope: 1.5% (one and one-half percent)
 - b. longitudinal slope: 4.5% maximum.

2. Setting Forms:
 - a. Firmly stake forms to the required line and grade.
 - b. Join forms neatly and in such manner that joints are free from play or movement in any direction.
 - c. Arrange forms to provide the specified transverse slope.
 - d. Project walks 1" above finish grade
 3. Preparation of Form Surfaces:
 - a. Clean form surfaces free of accumulated mortar or grout from previous concreting and foreign material.
 - b. Coat contact surfaces of forms with form coating compound.
 - c. Arrange forms to provide the specified transverse slope.
- C. Steel Welded Wire Fabric:
1. Welded Wire Fabric shall be placed as shown on the drawings.
 2. Mesh/Fabric shall be placed on steel or plastic supports spaced 2-3 feet, center to center.
 - a. Supports shall provide three (3") inch clearance above the sidewalk base.
 3. Mesh/Fabric shall be spliced/lapped: Fourteen (14") inches, excluding expansion joints.
- D. Preparation for Concrete Placement:
1. All surfaces which concrete is to be placed shall be free of debris, loose materials, standing water, snow, ice, and other deleterious substances before the start of concrete placing
- 3.02 INSTALLATION
- A. Constructing Joints:
1. Contraction Joints:
 - a. Provide transverse contraction joints full width of walk and at right angles to centerline of walk, spaced 5' on centers, and $\frac{1}{4}$ of concrete walk thickness.
 - b. Form contraction joints either by cutting joints method or by strip insertion method.
 - c. When cutting joints method is used, cut joint in the concrete after floating. Finish joints smooth and substantially true to line.
 - d. When strip insertion method is used, insert a premolded hardboard or fiberboard strip into the fresh concrete until the top surface of the strip is flush with the concrete surface. After the concrete has cured for at least 7 days, remove inserts and clean joint groove of foreign matter and loose particles.
 2. Expansion Joints:
 - a. Provide 1" thick expansion joints at right angles to centerline of walk at intervals not exceeding 50' and;
 - 1). at juncture with the walk at driveway crossings. and abutting curb and gutter faces.
 - b. Provide $\frac{1}{2}$ " thick expansion joints between sidewalk and adjacent existing walks and structures ,
 - c. Fill expansion joints with bituminous expansion joint filler strips extending the full depth of the concrete walk.
- B. Concrete Placing,
1. Conveying Concrete:
 - a. Transfer of Ready-Mixed Concrete at Project Site: Concrete shall be handled from the point of delivery and transfer to concrete conveying equipment and to the location of final deposit as rapidly as practicable by methods which will prevent segregation and loss of concrete mix materials and in a manner which will assure that the required quality of concrete is placed
 - b. Equipment for Conveying Concrete: Equipment shall be approved by the Owner and shall be of size and design that detectable silting of concrete shall not occur before adjacent concrete is placed.
 - c. Runways for wheeled concrete conveying equipment shall be provided for the ready mixed concrete from the delivery point to the locations of final deposit.

2. Concrete Placing:
 - a. Concrete Depositing in General: Concrete shall be deposited continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete placing shall be performed at such a rate that concrete which is being integrated with fresh concrete, is still plastic. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to re-handling or flow. Concrete which has partly hardened or has been contaminated by foreign materials shall not be deposited; such concrete shall be removed from the work and disposed of in an approved location.
 - b. Concrete shall not be placed during rain sufficient to cause erosion of the finished concrete surface or as to cause water to stand on completed yet plastic concrete. If rainfall should occur which may damage completed work, such work shall be protected with plastic sheeting. Concrete which has been damaged by rainfall shall be removed and replaced.
3. Tactile Warning Devices:

Where noted on the drawings install Tactile Warning Surfaces.
- C. Tolerances: The completed work will be field measured to insure compliance. The allowable variance from the plan and/or specified.
 - a. longitudinal and cross slope shall be +/- 0.25%.
 - b. thickness shall be +/- one quarter ($\frac{1}{4}$) inch.

3.03 FINISH & CURING

- A. Sidewalk Finish:
 1. Immediately after completion of float finish, round all edges and joints with an approved finishing tool having a radius of $\frac{1}{2}$ ".
 2. Broom surface to slightly roughen it and to remove the finishing tool marks.
- B. Curing Concrete:
 1. Curing: Curing shall be accomplished by membrane curing. Curing compound shall be applied to damp concrete surfaces as soon as the moisture film has disappeared from the surface of the concrete after finishing. The curing compound shall be applied uniformly in a two-coat continuous operation by power spraying equipment, using a sprayer equipped with a wind guard. The second coat shall be applied in a direction approximately at right angles to the direction of the first coat. The total coverage of the two coats shall be not more than 200 sq. ft. per gallon of curing compound. Concrete surfaces which are subjected to heavy rainfall, snow or sleet within 3 hours after the curing compound has been applied shall be re-sprayed by the method and at the rate specified above. Continuity of the coating shall be maintained for the entire curing period and any damage to the coating during the curing period shall be immediately repaired.
 2. White Pigmented curing compound shall be applied to all exterior concrete surfaces exposed to sunlight.
 3. Transparent curing compound shall be applied to all interior surfaces and surfaces to receive special surface treatments as specified elsewhere.
- C. Additional Protection of Concrete During Curing:
 1. Place approved barricades and lights around newly placed concrete walks to protect walks from traffic until concrete has cured sufficiently to bear traffic.
 2. Maintain barricades in place at driveways for a minimum of 5 days.
- D. After completion of concrete curing in an area, remove all weather protection materials and rubbish and debris resulting from specified work and sweep concrete walk surfaces clean.

END OF SECTION

SECTION 329119 – TOPSOIL

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes the Work consisting of labor material and equipment for topsoil on a prepared subgrade.
- B. Related Requirements:
 - 1. Grading Section 31-22-16.

1.02 REFERENCES

- A. Definitions:
 - 1. Friable: Friable is defined as a soil which is easily crumbled or pulverized.

1.03 INFORMATION SUBMITTALS

- A. Test Reports:
 - 1. Submit certification of material testing for every 500 cubic yards of topsoil delivered to the site.

1.04 QUALITY ASSURANCE

- A. Testing:
 - 1. Topsoil material shall be tested for conformity every 800 cyds of material and or every 5000 Syd as placed.

1.05 SITE CONDITIONS

- A. Environmental:
 - 1. Do not prepare or place soils that are dry, excessively wet or frozen.
 - 2. Do not prepare soils when adverse conditions exist that may preclude obtaining desired results.
- B. Existing Conditions:
 - 1. Grade Control: Establish and maintain the required lines and grades for lawn areas during construction operations.

2.01 MATERIALS

- A. Topsoil:
 - 1. Topsoil shall be fertile, friable, friable and representative of productive soil, capable of sustaining vigorous plant growth and shall be free of clay lumps, sub-soil, weeds, roots, seeds and other foreign debris (larger than 1").
 - 2. Material shall meet the following criteria.
 - a. Acidity range shall be between pH 5.5 and 7.5.
 - b. Organic content shall be not less than 5% and not greater than 30%.
 - c. Clay content shall range between 5% and 25%.
 - 3. Topsoil shall be unscreened farm field topsoil.

3.01 PREPARATION

- A. Preparation of earth bed.
 - 1. Eliminate uneven areas and low spots.

2. The earth bed subgrade upon which the topsoil is to be placed shall be at the required grade and properly trimmed. Just prior to placing topsoil all earth beds, which includes areas previously mulched or rye seeded for temporary erosion control, shall be harrowed into a friable condition with a disk, a spring tooth drag or a spike tooth drag to a minimum depth of 3" (three inches). The harrowing shall be done so that all soil impressions left by all equipment are horizontal across the face of the slope. All topsoil that has been placed on conditioned earth bed shall be incorporated into the upper of the earth bed. Topsoil shall not be worked when in a wet condition.

B. Physical Structures:

1. Flag/mark all drainage structures, and irrigation devices.
2. Place filter cloth or sediment control material over all drainage inlets.

3.02 PLACEMENT

- A. Place topsoil in areas as designated on the Contract Drawings. Thickness shall be as called for on the Contract Drawings. Place topsoil during dry weather. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
 1. Manually spread topsoil close to existing plant life, buildings and other above grade appurtenances to prevent damage.
- B. After spreading, any large clods and lumps shall be pulverized and all stones and rocks over 2" (two inches) in diameter, roots, litter and all foreign matter shall be raked up and disposed of by the Contractor off site.
- C. Tolerances:
 1. Top of Topsoil: Plus or minus ½ inch or as called for on the Plans.

3.03 CLEANING

- A. After topsoil has been placed to final grades, remove and dispose of grade sketches, surface trash, and other matter detrimental to future maintenance operations.
- B. Excess Items:
 1. Immediately clean up spillages of soil materials.
 2. Remove and dispose of excess materials upon completion of Work.

END OF SECTION

SECTION 329219 – SEEDING

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes materials and listings for the applications of seeds for lawns and grasses.
- B. Related Requirements:
 - 1. Topsoil 32-91-19
 - 2. Paving and Surface Restoration 32-01-10.
 - 3. Common Materials for Bases and Paving 32-05-16.

1.02 REFERENCES

- A. Definitions:
 - 1. Friable: Friable is defined as a soil which is easily crumbled or pulverized.
 - 2. Friable Condition: A soil in a “friable condition” is defined as a surface which is in a crumbled, pulverized, worked-up, loosened, or cultivated state; free of lumps and clods detrimental to seeding and sodding operations.
- B. Reference Standards:
 - 1. MDOT – Michigan Department of Transportation standard specification.

1.03 ACTION SUBMITTALS

- A. Product Data:
 - 1. Grass Seed Test Reports: Submit two copies of report covering grass seed purity and germination tests.

1.04 SITE CONDITIONS

- A. Environmental:
 - 1. Do not perform seeding work when adverse conditions exist, including high wind that may preclude obtaining desired results.
 - 2. Plant grass seed from the time soil is workable between April 1st and October 15th.
- B. Reconditioning Existing Lawns: Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of construction vehicles, and existing lawn areas as indicated.
 - 1. Provide fertilizer and seed as specified for new lawns and as required to provide a satisfactorily reconditioned lawn. Provide topsoil as required to fill low areas and meet new finish grades.
 - 2. Cultivate bare and compacted areas thoroughly.
 - 3. Remove diseased or unsatisfactory lawn areas. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, stone, gravel, and other construction materials. Where substantial but thin lawn remains, rake, aerate if compacted, and cultivate soil; fertilize and seed.
 - 4. Water newly seeded areas. Maintain adequate soil moisture until new grass is established.

2.01 MATERIALS

- A. Hand Seeding:
 - 1. Fertilizer shall be 5N-20P-20K.

2. Mulch shall be straw, hay, or any locally available mulch of acceptable quality as approved by the Engineer. Free of matured seed, noxious weeds or other materials which would be detrimental to lawn development or to future lawn maintenance.

B. Hydro-Seeding:

1. Fertilizer shall be 12N-20P-12K
2. Mulch shall be wood cellulose fiber mulch: Degradable wood cellulose fiber or 100% recycled long fiber pulp, free from weeds or other foreign matter toxic to seed germination and suitable for hydro-mulching.

C. Mulch Blanket shall be :

- 1 Photo degradable, polyethylene mesh:
 - a. single net- Western Excelsior SR1'
 - b. double net – Western Excelsior SR2
2. Bio degradable, suite, North American 3150 BN
3. Mulch blanket anchors shall be ;
 - a. 6" wood staples'
 - b. 6" steel staples,
 - c. 8' anchor staples

2.02 MIX

A. Seed Mixture shall be MDOT designations as follows:

1. "THM": Kentucky Blue Grass, Perennial Ryegrass, Hard Fescue, Creeping Red Fescue.
2. "TUF": Kentucky Blue Grass, Perennial Ryegrass, Hard Fescue, Creeping Red Fescue, Fufts Salt

Grass.

3.01 – EXECUTION

A. Preparation:

1. Preparation of Earth Bed: The earth bed upon which the topsoil is to be placed shall be at the required grade and properly trimmed. Prior to placing the topsoil, the earth bed shall be in a friable condition to a minimum depth of 3 inches. Earth beds shall be harrowed with a disk, a spring tooth drag or a spike tooth drag just prior to placing topsoil. The harrowing shall be done horizontally across the face of the slope. The tops and bottoms of all slopes shall be rounded to blend into the natural ground or adjacent slopes by vertical curves.
2. Fertilizing: For areas to be seeded, chemical fertilizer shall be evenly applied on the prepared topsoil surface at a rate which will provide 240 pounds per acre of chemical fertilizer nutrients, in equal proportions of Nitrogen, Phosphoric Acid and Potash, or as directed by the Engineer. Fertilizer spread by drill or broadcast methods will be placed or worked into the soil to a depth of one to two inches. Fertilizer and fertilizer-seed slurries spread hydraulically shall be incorporated into the soil.

3.02 SEEDING

A. Sowing:

1. Sow the seed following or in conjunction with fertilizing while the seed bed is in a friable condition. Just before seeding, harrow the topsoil and/or compost 3 inches deep or more. Harrow with a disk, a spring tooth drag, a spike tooth drag, or other equipment designed to prepare the soil to a friable condition and meeting the approval of the Engineer. Harrow horizontally across the face of the slope. Sow seed before applying mulch. Sow or resow the seed mixture, providing uniform coverage, at the rate of 220 lbs/acre. Sow with either mechanical drills, hydroseeders, or by broadcasting. Broadcast in areas to be resown or in areas that are inaccessible to a drill or hydrosseder.

2. Setting the Seed: Lightly compact or rake areas sown by hydroseed or broadcast methods to incorporate the seed into the uppermost ½ inch of the topsoil surface. Immediately after setting the seed, mulch

B. Hydro-Seeding/Mulch: Use a hydromulcher (sprayer) and apply mixture(s) at the following rates. Mix in accordance with manufacturer's recommendations.

1. Use for erosion prone slopes greater than 4:1 or drainage swales.
2. Apply mixture A hydroseed slurry to indicated steep erosion prone areas.
 - a. Seed: 250 lbs./acre.
 - b. Type A fertilizer: 200 lbs./acre.
 - c. Tackifier: 60 gals./acre.
 - d. Wood cellulose fiber mulch: 2,000 lbs./acre.

3.03 MULCH BLANKETS

A. Mulch Blankets: Place mulch blankets within one day after seeding. Overlap blanket side edges two inches. Shingle lap blanket ends 6 inches. Place staples or pegs along all joint edges and along blanket centerlines at a maximum spacing of two feet. However, in waterways single lap blankets with an overlap of 12 inches on the downslope edge. When blankets are installed from the top of the slope, do not allow them to free fall down the slope. Use net anchors recommended by the manufacturer. Steel wire staples or pins are not acceptable. Place and anchor blankets according to the manufacturer's directions if those requirements are greater than these minimum requirements.

B. Watering:

1. Water seeded areas, at 3.5 gallons per square yard when required. Continue watering regularly so that seed/seedlings do not dry out.
2. Water mulch blanket slopes two (2) intervals when directed by the Engineer.

END OF SECTION

SECTION 331217 – GATEWELLS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes specifications and methods for construction of water system gatewells. Sizes and details further described on the drawings.
- B. Related Requirements: Structural Excavation, Backfill and Compaction – Section 31-23-16; Submittals Section 01-33-00.

1.02 REFERENCES

- A. Definitions:
 - 1. Riser – The cylindrical barrel extends from the bottom of the gatewell (base) to the corbel or cone to the base of the gatewell frame.
 - 2. Cone – That portion of the pre-cast gatewell structure which slopes upward and inward from the barrel of the gatewell to the required gatewell frame diameter.
 - 3. Leveling Course refers to a section built of brick or block, precast rings mortared/rubber rings bolted in place, variable height, used to support and adjust finished grade of the gatewell frame.
- B. Reference Standards:
 - 1. MDOT Michigan Department of Transportation - "Standard Specifications for Construction".
 - 2. ASTM American Society of Testing Material – "Specific Volume/Article".
 - 3. AWWA – American Water Works Association.
 - 4. NSF 61 – ANSI/NSF Standard 61 – "Drinking Water System Components".

1.03 ACTION SUBMITTALS

- A. Submit product data sheets for the products specified.

PART 2 – PRODUCTS

2.01 PRE-CAST UNITS & APPURTENANCES

- A. Pre-cast concrete section risers, sumps and cones shall be fabricated according to ASTM C478.
 - 1. Pre-cast concrete units shall be circular with circular reinforcement.
 - a. Internal diameter of units shall conform to the dimensions shown on the drawings.
 - b. Openings for inlet or outlet pipes shall be pre-formed or by drilling out the opening with water cooled diamond bit.
 - c. Pre-cast unit joints shall be cast to receive "premium joint per ASTM C443.
 - 2. Cone units shall be eccentric.
 - 3. Pre-cast flat top slabs shall be designed for axle load and re-steel positions marked.
 - 4. Pre-cast riser rings shall be reinforced with two circular #4 re-bar. Thickness shall be 3", 4" or 6".
 - a. Riser rings shall be cast or drilled with holes for bolt tie downs.
- B. Steps:
 - 1. Steps shall be of an approved design and made of plastic coated steel.
 - 2. Rungs shall be a minimum of 10 inches in clear length, designed to prevent the foot from slipping off the end.
 - 3. Supplier shall be M.A. Industries or equal.

- C. Joint Materials:
 - 1. Joint materials shall be a full ring gasket per ASTM C443 unless noted or shown on the drawings.
 - 2. Preformed butyl rubber strip gasket shall conform to ASTM C990 - 1" Pro-stick (Press-Seal Gasket Corp).
- D. Resilient Pipe Connector:
 - 1. Resilient connector shall be natural synthetic rubber with stainless steel expansion rings and/or tension bands and/or take-up devices. Design of the connector shall provide a positive seal of the pipe exterior surface and the gatewell wall. Connector shall conform to ASTM C923.
 - 2. Suppliers: "Kor-n-Seal", "Presswedge II" or "Link-Seal".

2.02 GATE VALVE

- A. Gate Valves:
 - 1. Gate Valves shall be Resilient wedge type rated for 250 psi cold water working pressure. Valves shall be in full conformance with AWWA C515 and be NSF 61 certified. All external and exterior surfaces of the valve body and bonnet shall have a coating complying with AWWA C550.
 - 2. Valves shall be non-rising stem type.
 - 3. Gate Valve Supplier shall be: *East Jordan Iron Works model # 'Flowmaster'; or American Flow Control Series 2500.or C509, DWSD S-900*
- B. Vertical shafting from top valve to the gatewell cone cover shall be provided, when the distance is greater than seven feet six inches (7' – 6").
- C. Corp stop shall be 'key plug' type, AWWA taper thread inlet, ¾" x 1" outlet with grip joint. Ford model #1000-34G; Mueller # 15000.

2.03 GATEWELL FRAME & COVER

- A. Gatewell Frame and Cover.
 - 1. Frame base shall have four holes for the frame to the manhole cone and four counter-sunk stainless steel cap screws for bolting the cover to the frame.
 - a. Bolt circle for frame bolt holes shall be 33-3/4 inches in diameter.
 - 2. Cover shall be furnished with "o-ring" gasket and two "concealed pick holes".
 - 3. Cover shall have imprint "Waterford Twp" – "Water Department"
 - 4. Suppliers: East Jordan Iron Works – 1040; Neenah Foundry - R-1915-G.
- B. Frame Rod and Anchor:
 - 1. Frame rod shall be 5/8" inch threaded, cadmium plated, rod with cadmium plated steel washer and a neo-prene gasket. Length vary to meet field condition.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Pre-Cast Reinforced Concrete Units: Construct pre-cast reinforced concrete units according to Standard Details or as detailed on the project plans. Seal the joints with o-ring gasket. Use poured-in-place or pre-cast concrete footings. Support pre-cast concrete footings on a 6-inch subbase of compacted granular material.
 - 1. Align eccentric cones for position with respect to step and valve shaft centerline in the riser section.

- B. Leveling Course shall be constructed of pre-cast concrete rings or brick and mortar as detailed on the drawings.
 - 1. Pre-cast rings shall be set on o-ring gaskets [*mortar*], position on threaded tie anchor bolts.
 - 2. Brick or block shall be placed as shown on the drawings.
 - a. Place the first set of bricks or blocks on a full bed of mortar. Lay brick or block in courses with uniform mortar joints $\frac{1}{2}$ inch thick $\pm 1/8$ inch. Break joints by half the length of the brick or block on adjoining courses. Place courses level except where otherwise required. Strike and point joints so that the exposed surface is true and smooth.
 - b. Do not place masonry with mortar when the temperature is 36 °F or less.
- C. Frame and Cover: Furnish and install new covers, including frames on new or existing structures according to the contract documents. Place castings on a full mortar bed.

3.02 VALVE INSTALLATION

- A. Gate Valve shall be positioned plumb and on the watermain. Valve shall be supported with concrete block and bag mix concrete.
- B. "Corp" fittings shall be placed in the watermain pipe, each side of the gate valve.

3.03 CLEAN-UP

- A. Maintain all gatewells installed on the project. All installed gatewells must be free of silt, debris, and other foreign matter at the time of final acceptance.

END OF SECTION

SECTION 331219 – TAPPING SLEEVE AND GATE

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes specifications and methods for construction of tapping sleeve gate and wells for existing water systems. Sizes 4 inch to 24 inch sleeves with 4" through 12" outlets, and details further described on the drawings.
- B. Related Requirements:
Trenching, Backfilling and Compaction – Section 31-23-33;
Gate Valve and Wells- Section 31-12-17

1.02 REFERENCES

- A. Definitions:
 - 1. Riser – The cylindrical barrel extends from the bottom of the gatewell (base) to the corbel or cone to the base of the gatewell frame.
 - 2. Cone – That portion of the pre-cast gatewell structure which slopes upward and inward from the barrel of the gatewell to the required gatewell frame diameter.
- B. Reference Standards:
 - 1. AWWA – American Water Works Association.
 - 2. NSF 61 – ANSI/NSF Standard 61 – "Drinking Water System Components".

1.03 ACTION SUBMITTALS 01-33-00

- A. Submit product data sheets for the products specified.\

PART 2 – PRODUCTS

2.01 PRE-CAST UNITS & APPURTENANCES see section 31-12-17

2.02 TAPPING SLEEVE

- A. Tapping Sleeve:
 - 1. Sleeve body, bars, bolts and nuts shall be 18-8 stainless steel
 - 2. Flange shall be Ductile steel or stainless steel conforming to AWWA C207, Class D ANSI 150 lb. drilling
 - 3. Gasket shall be full circle .
 - 4. Sleeve shall be : Ford- FAST type or Smith Blair ???

2.03 GATE VALVE, GATEWELL FRAME & COVER same as 32-12-17

2.04 CONCRETE

- A. Concrete shall be Grade 3.0, 3000 psi at 28 days
 - 1. Aggregate : 6A ,
 - 2. 5 sacks. type I Portland cement.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Explore Excavate;
 - 1. Excavate in vicinity of the tap and measure the outside diameter of the water main to be tapped.
 - 2. Order the specified sleeve for the measured diameter

3.02 SLEEVE INSTALLATION

- A. Sleeve outlet shall be positioned horizontal and the gate valve positioned vertical.
 - 1. Pressure test the sleeve to insure no visible drippage.
 - 2. Cast concrete blocking as shown on the drawings

3.03 INSTALLATION

- A. Pre-Cast Reinforced Concrete Units: see 33-12-17
 - 1. Align eccentric cones and frame and cover for position with respect to steps and valve operator shaft centerline to clear the access frame in the riser section.
- B. Frame and Cover: Same

3.04 CLEAN-UP

- A. Maintain all gatewells installed on the project. All installed gatewells must be free of silt, debris, and other foreign matter at the time of final acceptance.

END OF SECTION