Wayne State University
FAB Roof Top Units Replacement Re-Bid 2015
WSU Project Number 130-252650-4
Prevailing Wage Work

FOR:
Board of Governors
Wayne State University
Detroit, Michigan

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 and copy Ab3577@wayne.edu

Owner's Representative:
Omar Alhyari, Project Manager
Facilities Planning & Management
Design & Construction Services
5454 Cass
Wayne State University
Detroit, Michigan 48202

Consultant:
DiClemente Siegel Design Inc.
28105 Greenfield Road
Southfield, MI 48076

February 9, 2015
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INFORMATION FOR BIDDERS

OWNER: Board of Governors
Wayne State University

PROJECT: FAB Roof Top Units Replacement Re-Bid 2015
Project No. 130-252650-4

LOCATION: Wayne State University
656 West Kirby Avenue, Detroit, MI 48202
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 Ab3577@wayne.edu

OWNER’S REPRESENTATIVE: Omar Alhyari, Project Manager
Facilities Planning & Management
Design & Construction Services
Wayne State University
5454 Cass Avenue
Detroit, Michigan 48202

Architect: DiClemente Siegel Design Inc.
28105 Greenfield Road
Southfield, MI 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: February 9, 2015

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 February 9, 2015. 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: 10:00 am, local time, February 16, 2015 to be held at Wayne State University – 5454 Cass Ave., Conf. # 3, 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 February 18, 2015 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 Cynthia Branch, Buyer at: Ab3577@wayne.edu.

Bids Due: Sealed proposals for lump-sum General Contract will be received at the office of the Procurement & Strategic Sourcing located at 5700 Cass Avenue, Suite 4200, Detroit, MI 48202 on February 23, 2015, 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: FAB Roof Top Units Replacement Re-Bid 2015
Project No. 130-252650-4

LOCATION: Wayne State University
656 West Kirby Avenue, Detroit, MI 48202,
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 Ab3577@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 theses 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 Procurement & Strategic Sourcing.
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.

B. It will be the Contractor's responsibility to remit use tax for the items we pre-purchased, in compliance with the State of Michigan Revenue Administrative Bulletin 1999 – 2. A copy of our Purchase Order for the pre-purchase of the rooftop units will be provided to the successful contractor. Use tax paid to the State is to be invoiced at cost to the University, and is not part of the lump sum bid.

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, of which all 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.


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 **February 9, 2015** through Wayne State University Procurement & Strategic Sourcing’s Website for Advertised Bids: [http://www.forms.purchasing.wayne.edu/Adv_bid/Adv_bid.html](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 Procurement & Strategic Sourcing’s Website.** All available information pertaining to this project will be posted to the Purchasing website at [http://www.forms.purchasing.wayne.edu/Adv_bid/Adv_bid.html](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:  FAB Roof Top Units Replacement Re-Bid 2015

PROJECT NOS.:  WSU PROJECT NO. 130-252650-4

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

Wayne State University
5454 Cass Ave., Conf. # 3
Detroit MI  48202

10:00 am, local time, February 16, 2015

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 $7.00.  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, Procurement & Strategic Sourcing. 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 February 18, 2015, 12:00 noon.

IV. Proposal Due Date- February 23, 2015, 2:00 p.m.

V. Final Comments

VI. Adjourn
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: FAB Roof Top Units Replacement Re-Bid 2015

PROJECT NO.: WSU PROJECT NO. 130-252650-4

PROJECT TYPE: General Construction  
Mechanical Construction 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 Ab3577@wayne.edu

OWNER’S REPRESENTATIVE: Omar Alhyari, 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 FAB Roof Top Units Replacement Re-Bid 2015 project (WSU Project No. 130-252650-4) 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 ORDERS: (revised 4-01-2011) The undersigned agrees to the following pricing formula and rates for changes in the contract work:

1. For subcontract work, Contractor’s markup for handling, overhead, profit and bonding on subcontractors 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 May 15, 2015.

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 $300.00.00, Five Hundred Dollars per day, and therefore the contractor shall pay as liquidated damages to the Owner the sum of $300.00.00, Five Hundred 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.

It will be the Contractor’s responsibility to remit use tax for the items we pre-purchased, in compliance with the State of Michigan Revenue Administrative Bulletin 1999 – 2. A copy of our Purchase Order for the pre-purchase of the rooftop units will be provided to the successful contractor. Use tax paid to the State is to be invoiced at cost to the University, and is not part of the lump bid.

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__________________

FORM OF PROPOSAL FOR THE GENERAL CONTRACT 00300 - 2
CONTRACTOR'S PREQUALIFICATION STATEMENT & QUESTIONNAIRE:

Our Minimum Requirements for Construction Bids are:

WSU considers this project: General Construction
Mechanical Construction Work.

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

Contractors must complete the following information to determine their eligibility to participate in this bid. This information is required with your Bid to the University

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

Check one of the following on the makeup of your company:

_____ 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 Prevailing Wage Rates? 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" (see section 00500 of the bid documents), 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:**

**FAX NUMBER:**

**SIGNED BY:**

(please print or type name here)

**EMAIL ADDRESS:**

@
PREVAILING WAGE RATE SCHEDULE (revised 4-05-2010)

A. See also Page 00100-4 Section 12.B

B. Wayne State University requires all project contractors, including subcontractors, who provide labor on University projects to compensate at a rate no less than prevailing wage rates.

C. The rates of wages and fringe benefits to be paid to each class of laborers and mechanics by each VENDOR and subcontractor(s) (if any) shall be not less than the wage and fringe benefit rates prevailing in Wayne County, Michigan, as determined by the United States Secretary of Labor. Individually contracted labor commonly referred to as “1099 Workers” and subcontractors using 1099 workers are not acceptable for work related to this project.

D. To maintain compliance with State of Michigan Ordinances, Certified Payroll must be provided for each of the contractor's or subcontractor's payroll periods for work performed on this project. Certified Payroll should accompany all Pay Applications. Failure to provide certified payroll will constitute breach of contract, and pay applications will be returned unpaid, and remain so until satisfactory supporting documents are provided.

A Prevailing Wage Rate Schedule has been issued from the State of Michigan that is enclosed in this section.

Additional information can be found on the University Procurement & Strategic Sourcing's web site at the following URL address:

http://purchasing.wayne.edu/vendors/wage-rates.php

If you have any questions, or require rates for additional classifications, please contact:

Michigan Department of Consumer & Industry Services,
Bureau of Safety and Regulation, Wage and Hour Division,
7150 Harris Drive,
P.O. Box 30476,
Lansing, Michigan 48909-7976

http://www.michigan.gov/dleg/0,1607,7-154-27673_27706---,00.html

F. Wayne State University's Prevailing Wage Requirements:

When compensation will be paid under prevailing wage requirements, the University shall require the following:

A. The contractor shall obtain and keep posted on the work site, in a conspicuous place, a copy of all current prevailing wage and fringe benefit rates.

B. The contractor shall obtain and keep an accurate record showing the name and occupation of and the actual wages and benefits paid to each laborer and mechanic employed in connection with this contract.

C. The contractor shall submit a completed certified payroll document [U.S. Department of Labor Form WH 347] 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.

D. 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.
E. Apprentices for a skilled trade must provide proof of participation in a Certified Apprenticeship Program and the level of hours completed in the program.

F. 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.

G. If the VENDOR or subcontractor fails to pay the prevailing rates of wages and fringe benefits and does not cure such failure within 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:

1. Withhold all or any portion of payments due the VENDOR as may be considered necessary by the UNIVERSITY to pay laborers and mechanics the difference between the rates of wages and fringe benefits required by this contract and the actual wages and fringe benefits paid;

2. Terminate this contract and proceed to complete the contract by separate agreement with another vendor or otherwise, in which case the VENDOR and its sureties shall be liable to the UNIVERSITY for any excess costs incurred by the UNIVERSITY.

3. Propose to the Director of Purchasing that the Vendor be considered for Debarment in accordance with the University’s Debarment Policy, found on our website at http://purchasing.wayne.edu/docs/appm28.pdf

Terms identical or substantially similar to this section of this RFP shall be included in any contract or subcontract pertaining to this project.

H. The current applicable prevailing wage rates as identified by the State of Michigan Department of Consumer & Industry Services, Bureau of Safety and Regulation, Wage and Hour Division are attached. Refer to item C above if additional information is required.

I. 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 letter of intent or contract will not be issued to the apparent low bidder until this document is provided. The apparent low bidder will have one week to produce this document. If the required document is not received within this time, the bidder will be disqualified, and the next low bidder will be required to provide this schedule of values.

SEE ATTACHED STATE PREVAILING WAGE INFORMATION
Wayne County
Official 2015 Prevailing Wage Rates for State Funded Projects

Issue Date: 2/5/2015

Contract must be awarded by: 5/6/2015

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half</th>
<th>Double Time</th>
<th>Overtime Provision</th>
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<tbody>
<tr>
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<td>$53.64</td>
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<td>4 ten hour days @ straight time allowed</td>
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<td>Monday-Saturday, must be consecutive</td>
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<td>8/14/2009</td>
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Apprentice Rates:

| 1st 6 months           | $40.31 | $59.49 | $78.67 |
| 2nd 6 months           | $41.45 | $61.21 | $80.95 |
| 3rd 6 months           | $42.57 | $62.88 | $83.19 |
| 4th 6 months           | $43.69 | $64.57 | $85.43 |
| 5th 6 months           | $44.81 | $66.24 | $87.67 |
| 6th 6 months           | $49.53 | $73.40 | $97.26 |
| 7th 6 months           | $49.32 | $73.01 | $96.69 |
| 8th 6 months           | $51.58 | $76.40 | $101.21 |
### Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015

<table>
<thead>
<tr>
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<th>Double Time</th>
<th>Overtime Provision</th>
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<tbody>
<tr>
<td>Bricklayer</td>
<td>Bricklayer, stone mason, pointer, cleaner</td>
<td>BR1 10/15/2014</td>
<td>$52.43 $78.65</td>
<td>$104.86 H H D D D D</td>
<td>H H D D D D Y</td>
</tr>
</tbody>
</table>
|                | Make up day allowed comment **Saturday for 5 day 8 hour week**  
**Friday for 4 day 10 hour week**  
4 10s allowed M-TH |
|                | Apprentice Rates: | | | | |
|                | First 6 months | | $31.87 $47.81 | $63.74 |
|                | 2nd 6 months | | $33.72 $50.60 | $67.44 |
|                | 3rd 6 months | | $35.57 $53.37 | $71.14 |
|                | 4th 6 months | | $37.42 $56.14 | $74.84 |
|                | 5th 6 months | | $39.27 $58.92 | $78.54 |
|                | 6th 6 months | | $41.12 $61.70 | $82.24 |
|                | 7th 6 months | | $42.97 $64.46 | $85.94 |
|                | 8th 6 months | | $44.82 $67.24 | $89.64 |
| Carpenter      | Diver | CA 687 D 6/25/2014 | $64.65 $93.14 | $121.63 X X H X H D D Y |
|                | Make up day allowed comment **Saturday** |

Official Request #: 150  
Requestor: Wayne State University  
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof  
Project Number: 130-252650  
County: Wayne

**Official Rate Schedule**  
Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.
### Official 2015 Prevailing Wage Rates for State Funded Projects

#### Issue Date:
2/5/2015

#### Contract must be awarded by:
5/6/2015

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name Description</th>
<th>Last Updated</th>
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<th>Double Time</th>
<th>Overtime Provision</th>
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<tbody>
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<td>$91.14</td>
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**Apprentice Rates:**

- 1st 6 months: $24.23, $32.71, $41.18
- 2nd 6 months: $28.25, $38.73, $49.22
- 3rd 6 months: $30.35, $41.88, $53.42
- 4th 6 months: $32.44, $45.02, $57.60
- 5th 6 months: $34.54, $48.17, $61.80
- 6th 6 months: $36.63, $51.31, $65.98
- 7th 6 months: $38.74, $54.48, $70.20
- 8th 6 months: $40.82, $57.59, $74.36

**Carpenter**

<table>
<thead>
<tr>
<th>Name Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half Hourly</th>
<th>Double Time</th>
<th>Overtime Provision</th>
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<tbody>
<tr>
<td></td>
<td>CA687Z1 6/24/2014</td>
<td>$55.24</td>
<td>$79.04</td>
<td>$102.84</td>
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</table>

- four 10s allowed Mon-Sat; double time due when over 12 hours worked per day

- *Make up day allowed comment*

- Saturdays

**Apprentice Rates:**

- 1st year: $33.82, $46.92, $60.00
- 3rd 6 months: $36.21, $50.49, $64.78
- 4th 6 months: $38.58, $54.05, $69.52
- 5th 6 months: $40.97, $57.64, $74.30
- 6th 6 months: $43.33, $61.17, $79.02
- 7th 6 months: $45.72, $64.77, $83.80
- 8th 6 months: $48.09, $68.32, $88.54
# Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015  
**Page 4 of 33**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name Description</th>
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<th>Double Time</th>
<th>Overtime Provision</th>
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<td>Hourly</td>
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<td>Piledriver</td>
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<td>$79.04</td>
<td>$102.84 X X X H H D Y</td>
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</table>

Four 10s allowed Monday-Saturday; double time due when over 12 hours worked per day

*Make up day allowed comment*

Saturday

- **Apprentice Rates:**
  - 1st 6 months: $33.82 $46.92 $60.00
  - 2nd 6 months: $38.58 $54.05 $69.52
  - 3rd 6 months: $43.33 $61.17 $79.02
  - 4th 6 months: $48.09 $68.32 $88.54

Cement Mason

<table>
<thead>
<tr>
<th>Name Description</th>
<th>Last Updated</th>
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<th>Double Time</th>
<th>Overtime Provision</th>
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<td>$71.17 X X H H H</td>
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- **Apprentice Rates:**
  - 1st 6 months: $29.13 $39.45 $49.77
  - 2nd 6 months: $31.20 $42.54 $53.87
  - 3rd 6 months: $35.31 $48.67 $62.01
  - 4th 6 months: $39.46 $54.85 $70.23
  - 5th 6 months: $41.52 $57.91 $74.30
  - 6th 6 months: $45.67 $64.10 $82.52

Cement Mason

<table>
<thead>
<tr>
<th>Name Description</th>
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<th>Straight Time and a Half</th>
<th>Double Time</th>
<th>Overtime Provision</th>
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- **Apprentice Rates:**
  - 1st 6 months: $26.77 $36.07 $45.36
  - 2nd 6 months: $28.68 $38.91 $49.13
  - 3rd 6 months: $32.50 $44.59 $56.66
  - 4th 6 months: $36.32 $50.26 $64.19
  - 5th 6 months: $38.24 $53.11 $67.98
  - 6th 6 months: $42.06 $58.79 $75.51

---

**Official Request #: 150**  
**Requestor:** Wayne State University  
**Project Description:** Install Roof Top Units, Upgrade Control System & Repair Roof  
**Project Number:** 130-252650  
**County:** Wayne  

**Official Rate Schedule**

Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.
### Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015  
**Page 5 of 33**

#### Classification

<table>
<thead>
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<tr>
<td>Make up day allowed</td>
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<td>Friday make-up day for bad weather or holidays</td>
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<td>$40.67 $50.27</td>
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<th>Double Time</th>
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<tbody>
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<td>Elevator Constructor</td>
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<td>Elevator Constructor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make up day allowed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apprentice Rates:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1st Year Apprentice</td>
<td></td>
<td>$37.74</td>
<td>$58.93</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2nd Year Apprentice</td>
<td></td>
<td>$41.90</td>
<td>$66.94</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Year Apprentice</td>
<td></td>
<td>$43.98</td>
<td>$70.95</td>
<td></td>
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<tr>
<td></td>
<td>4th Year Apprentice</td>
<td></td>
<td>$48.14</td>
<td>$78.96</td>
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<tr>
<td>Glazier</td>
<td>Glazier</td>
<td>GL-357</td>
<td>$47.35</td>
<td>$65.97</td>
<td>$84.58 H H H H H H D Y</td>
</tr>
<tr>
<td></td>
<td>Apprentice Rates:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1st 6 months</td>
<td></td>
<td>$32.45</td>
<td>$43.62</td>
<td>$54.78</td>
</tr>
<tr>
<td></td>
<td>2nd 6 months</td>
<td></td>
<td>$33.94</td>
<td>$45.85</td>
<td>$57.76</td>
</tr>
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<td></td>
<td>3rd 6 months</td>
<td></td>
<td>$36.92</td>
<td>$50.33</td>
<td>$63.72</td>
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<tr>
<td></td>
<td>4th 6 months</td>
<td></td>
<td>$38.41</td>
<td>$52.56</td>
<td>$66.70</td>
</tr>
<tr>
<td></td>
<td>5th 6 months</td>
<td></td>
<td>$39.90</td>
<td>$54.79</td>
<td>$69.68</td>
</tr>
<tr>
<td></td>
<td>6th 6 months</td>
<td></td>
<td>$41.39</td>
<td>$57.03</td>
<td>$72.66</td>
</tr>
<tr>
<td></td>
<td>7th 6 months</td>
<td></td>
<td>$42.88</td>
<td>$59.27</td>
<td>$75.64</td>
</tr>
<tr>
<td></td>
<td>8th 6 months</td>
<td></td>
<td>$45.86</td>
<td>$63.73</td>
<td>$81.60</td>
</tr>
<tr>
<td>Heat and Frost Insulator</td>
<td>Spray Insulation</td>
<td>AS25S</td>
<td>$20.14</td>
<td>$29.14</td>
<td>H H H H H H H H H H N</td>
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Official Request #: 150
Requestor: Wayne State University
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof
Project Number: 130-252650
County: Statewide
# Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015

## Heat and Frost Insulator and Asbestos Worker

<table>
<thead>
<tr>
<th>Name Description</th>
<th>AS25</th>
<th>1/29/2014</th>
<th>$60.25</th>
<th>$76.00</th>
<th>$91.74</th>
<th>H</th>
<th>H</th>
<th>H</th>
<th>H</th>
<th>H</th>
<th>D</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat and Frost Insulators and Asbestos Workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Four 10s must be worked for a minimum of 2 weeks consecutively, Monday thru Thursday. All hours worked in excess of 10 will be paid at double time. All hours worked on the fifth day,

**comment**

Four 10s must be worked for a minimum of 2 consecutive weeks. OVERTIME is different on a four 10 week. OT is 2x for hours beyond 10. All hours on fifth day, M-F require time and one half. Sat first 8 hours, 1.5, all hours after 8 require double time.

### Apprentice Rates:

<table>
<thead>
<tr>
<th>Level</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
<th>4th Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>60% Level</td>
<td>$46.08</td>
<td>$49.23</td>
<td>$50.80</td>
<td>$53.95</td>
</tr>
<tr>
<td>65% Level</td>
<td>$46.08</td>
<td>$49.23</td>
<td>$50.60</td>
<td>$53.95</td>
</tr>
<tr>
<td>70% Level</td>
<td>$46.08</td>
<td>$49.23</td>
<td>$50.80</td>
<td>$53.95</td>
</tr>
<tr>
<td>75% Level</td>
<td>$46.08</td>
<td>$49.23</td>
<td>$50.80</td>
<td>$53.95</td>
</tr>
<tr>
<td>80% Level</td>
<td>$46.08</td>
<td>$49.23</td>
<td>$50.80</td>
<td>$53.95</td>
</tr>
<tr>
<td>85% Level</td>
<td>$46.08</td>
<td>$49.23</td>
<td>$50.80</td>
<td>$53.95</td>
</tr>
</tbody>
</table>

## Ironworker

<table>
<thead>
<tr>
<th>Name Description</th>
<th>IR-25-F1</th>
<th>8/13/2014</th>
<th>$34.20</th>
<th>$46.45</th>
<th>$58.69</th>
<th>X</th>
<th>X</th>
<th>H</th>
<th>X</th>
<th>X</th>
<th>H</th>
<th>D</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fence, Sound Barrier &amp; Guardrail erection/installation and Exterior Signage work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Four ten hour work days may be worked during Monday-Saturday.

### Apprentice Rates:

<table>
<thead>
<tr>
<th>Level</th>
<th>60% Level</th>
<th>65% Level</th>
<th>70% Level</th>
<th>75% Level</th>
<th>80% Level</th>
<th>85% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>60% Level</td>
<td>$23.04</td>
<td>$23.04</td>
<td>$23.04</td>
<td>$23.04</td>
<td>$23.04</td>
<td>$23.04</td>
</tr>
<tr>
<td>70% Level</td>
<td>$25.70</td>
<td>$25.70</td>
<td>$25.70</td>
<td>$25.70</td>
<td>$25.70</td>
<td>$25.70</td>
</tr>
<tr>
<td>75% Level</td>
<td>$27.02</td>
<td>$27.02</td>
<td>$27.02</td>
<td>$27.02</td>
<td>$27.02</td>
<td>$27.02</td>
</tr>
<tr>
<td>80% Level</td>
<td>$28.34</td>
<td>$28.34</td>
<td>$28.34</td>
<td>$28.34</td>
<td>$28.34</td>
<td>$28.34</td>
</tr>
<tr>
<td>85% Level</td>
<td>$29.67</td>
<td>$29.67</td>
<td>$29.67</td>
<td>$29.67</td>
<td>$29.67</td>
<td>$29.67</td>
</tr>
</tbody>
</table>

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**Official Request #: 150**  
**Requestor:** Wayne State University  
**Project Description:** Install Roof Top Units, Upgrade Control System & Repair Roof  
**Project Number:** 130-252650  
**County:** Wayne

---

**Official Rate Schedule**  
Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.
### Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015

#### Page 8 of 33

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half Update</th>
<th>Double Time Update</th>
<th>Overtime Provision</th>
</tr>
</thead>
</table>
| Siding, Glazing, Curtain Wall | IR-25-GZ2 | 9/4/2014 | $46.41 | $58.07 | $69.73 | X | X | H | H | H | D | D | Y | 4 tens may be worked Monday thru Thursday @ straight time.

  *Make up day allowed* comment

  Friday

  **Apprentice Rates:**
  - Level 1: $29.48, $36.09, $42.68
  - Level 2: $31.59, $38.83, $46.05
  - Level 3: $33.71, $41.58, $49.44
  - Level 4: $35.83, $44.33, $52.82
  - Level 5: $37.94, $47.07, $56.20
  - Level 6: $40.06, $49.82, $59.58

Pre-engineered Metal Work  
IR-25-PE-Z1  6/3/2014  $45.24  $55.53  $65.81  X  X  H  X  X  X  X  D  Y  4 tens allowed M-Th with Saturday make up day

  *Make up day allowed* comment

**Apprentice Rates:**
  - 1st Year: $26.11, $31.58, $37.06
  - 3rd 6 month period: $28.23, $34.46, $40.68
  - 4th 6 month period: $30.36, $37.35, $44.33
  - 5th 6 month period: $32.48, $40.21, $47.95
  - 6th 6 month period: $34.61, $43.99, $53.37

Reinforced Iron Work  
IR-25-RF  9/3/2014  $55.36  $82.91  $110.45  H  H  H  D  D  D  D  D  N  Make up day allowed

**Apprentice Rates:**
  - Level 1: $36.01, $53.89, $71.75
  - Level 2: $38.38, $57.43, $76.49
  - Level 3: $40.74, $60.98, $81.21
  - Level 4: $43.28, $64.78, $86.29
  - Level 5: $45.81, $68.59, $91.35
  - Level 6: $48.35, $72.39, $96.43
Official 2015 Prevailing Wage Rates for State Funded Projects

Issue Date: 2/5/2015
Contract must be awarded by: 5/6/2015

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name Description</th>
<th>Updated</th>
<th>Straight Time and a Half</th>
<th>Double Time</th>
<th>Overtime Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigging Work</td>
<td>IR-25-RIG 9/3/2014</td>
<td>$61.33</td>
<td>$91.67</td>
<td>$122.00</td>
<td>H H H H H D N</td>
</tr>
</tbody>
</table>

Apprentice Rates:
- Level 1 & 2: $36.63, $54.59, $72.55
- Level 3: $39.46, $58.84, $78.21
- Level 4: $42.28, $63.07, $83.85
- Level 5: $45.11, $67.31, $89.51
- Level 6: $47.94, $71.56, $95.17

Decking
4 tens may be worked Monday thru Thursday @ straight time. If bad weather, Friday may be a make up day. If holiday celebrated on a Monday, 4 10s may be worked Tuesday thru Friday. Work in excess of 12 hours per day must be paid @ double time.

Make up day allowed

Apprentice Rates:
- Levels 1 & 2: $36.05, $54.01, $71.97
- Level 3: $38.88, $58.26, $77.63
- Level 4: $41.70, $62.49, $83.27
- Level 5: $44.53, $66.73, $88.93
- Level 6: $47.36, $70.98, $94.59
- Level 7: $50.18, $75.20, $100.23
- Level 8: $53.01, $79.46, $105.89

Structural, ornamental, welder and pre-cast
4 tens may be worked Monday thru Thursday @ straight time. If bad weather, Friday may be a make up day. If holiday celebrated on a Monday, 4 10s may be worked Tuesday thru Friday. Work in excess of 12 hours per day must be paid @ double time.

Make up day allowed

Apprentice Rates:
- Levels 1 & 2: $36.05, $54.01, $71.97
- Level 3: $38.88, $58.26, $77.63
- Level 4: $41.70, $62.49, $83.27
- Level 5: $44.53, $66.73, $88.93
- Level 6: $47.36, $70.98, $94.59
- Level 7: $50.18, $75.20, $100.23
- Level 8: $53.01, $79.46, $105.89

Official Request #: 150
Requestor: Wayne State University
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof
Project Number: 130-252650
County: Wayne
Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015

**Contract must be awarded by:** 5/6/2015

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<table>
<thead>
<tr>
<th>Classification</th>
<th>Name</th>
<th>Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half</th>
<th>Double Time</th>
<th>Overtime Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Door erection &amp; construction</td>
<td>IR-25-STR-D</td>
<td>9/4/2014</td>
<td>$42.02</td>
<td>$62.68</td>
<td>$83.33</td>
<td>H H H H H D Y</td>
</tr>
<tr>
<td>Make up day allowed</td>
<td>comment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friday for bad weather when 4 tens scheduled for M-Th. If holiday celebrated on M, 4 tens may be worked T-F. Work in excess of 12 hours per day must be paid @ double time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laborer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Laborer, Demolition Laborer, Mason Tender, Carpenter Tender, Drywall Handler, Concrete Laborer, Cement Finisher Tender, Concrete Chute, and Concrete Bucket Handler</td>
</tr>
<tr>
<td>L33401-A-CC</td>
</tr>
<tr>
<td>Make up day allowed</td>
</tr>
<tr>
<td>If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Apprentice Rates:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1,000 work hours</td>
</tr>
<tr>
<td>1,001 - 2,000 work hours</td>
</tr>
<tr>
<td>2,001 - 3,000 work hours</td>
</tr>
<tr>
<td>3,001 - 4,000 work hours</td>
</tr>
</tbody>
</table>

| Signal Man (on sewer & caisson work), Air, Electric or Gasoline Tool Operator, Concrete Vibrator Operator, Acetylene Torch & Air Hammer Operator, Scaffold Builder, Caisson Worker |
| L33401-B-SB | 7/16/2013 | $43.80 | $62.33 | $80.85 | H H H H H D Y |
| Make up day allowed | comment |
| If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8 |

Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.
Official 2015 Prevailing Wage Rates for State Funded Projects

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name and Description</th>
<th>Last Updated</th>
<th>Straight Time and Overtime Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Furnace Battery Heater Tender, Burning Bar &amp; Oxy-Acetylene Gun</td>
<td>7/16/2013</td>
<td>$44.04 $62.69 $81.33 H H H H H Y</td>
</tr>
<tr>
<td></td>
<td>Expediter Man, Top Man and/or Bottom Man (Blast Furnace Work or Battery Work)</td>
<td>7/16/2013</td>
<td>$44.79 $63.81 $82.83 H H H H H Y</td>
</tr>
<tr>
<td></td>
<td>Cleaner/Sweeper Laborer; Furniture Laborer</td>
<td>7/16/2013</td>
<td>$38.09 $53.76 $69.43 H H H H H Y</td>
</tr>
<tr>
<td></td>
<td>Lansing Burner, Blaster &amp; Powder Man; Air, Electric or Gasoline Tool Operator (Blast Furnace Work or Battery Work)</td>
<td>7/16/2013</td>
<td>$44.29 $63.06 $81.83 X X H H H D Y</td>
</tr>
</tbody>
</table>

If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8 hours of work on Saturdays @ straight time. Make up day allowed comment Saturday

Official Rate Schedule

Requestor: Wayne State University
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof
Project Number: 130-252650
County: Wayne

Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.
## Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015  
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<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
<th>Updated</th>
<th>Last Straight Time and a Half Double Overtime Provision</th>
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</thead>
<tbody>
<tr>
<td>Plasterer Tender, Plastering Machine Operator</td>
<td>LPT-1</td>
<td>10/25/2013</td>
<td>$43.54</td>
</tr>
</tbody>
</table>

If conditions beyond the employer/employee's control prevent one or more hours of working during Mon-Fri, the employer may choose to work up to 10 hour straight time weekdays. Work may be scheduled up to 10 hours per Mon-Fri for the purpose of reaching 40 hours @ straight time. Make up days may also include 8 Saturday  

**Apprentice Rates:**
- 0 - 1,000 hours: $37.60, $53.03, $68.45
- 1,001 - 2,000 hours: $38.79, $54.81, $70.83
- 2,001 - 3,000 hours: $39.98, $56.60, $73.21
- 3,001 - 4,000 hours: $42.35, $60.15, $77.95

**Laborer - Hazardous**
- Class A performing work in conjunction with site preparation and other preliminary work prior to actual removal, handling, or containment of hazardous waste substances not requiring use of personal protective equipment required by state or federal regulations; or a laborer performing work in conjunction with the removal, handling, or containment of hazardous waste substances when use of personal protective equipment level "D" is required.  
  
  **Make up day allowed comment**
  - 4 10s allowed M-Th or T-F; inclement weather makeup day Friday

**Apprentice Rates:**
- 0-1,000 work hours: $37.60, $53.03, $68.45
- 1,001-2,000 work hours: $38.79, $54.81, $70.83
- 2,001-3,000 work hours: $39.98, $56.60, $73.21
- 3,001-4,000 work hours: $42.35, $60.15, $77.95
Official 2015 Prevailing Wage Rates for State Funded Projects

Issue Date: 2/5/2015
Contract must be awarded by: 5/6/2015
Page 13 of 33

Classification | Name | Description | Last Updated | Straight Time and a Half Rate | Double Time Rate | Overtime Provision |
----------------|-------|-------------|--------------|-----------------------------|-----------------|--------------------|
Class B performing work in conjunction with the removal, handling, or containment of hazardous waste substances when the use of personal protective equipment levels "A", "B" or "C" is required.

Make up day allowed comment
4 10s allowed M-Th or T-F; inclement weather makeup day Friday

Apprentice Rates:
0-1,000 work hours | $38.36 | $54.17 | $69.97
1,001-2,000 work hours | $39.59 | $56.01 | $72.43
2,001-3,000 work hours | $40.83 | $57.87 | $74.91
3,001-4,000 work hours | $43.30 | $61.58 | $79.85

Laborer Underground - Tunnel, Shaft & Caisson
Class I - Tunnel, shaft and caisson laborer, dump man, shanty man, hog house tender, testing man (on gas), and watchman.

Apprentice Rates:
0-1,000 work hours | $33.05 | $41.43 | $49.98
1,001-2,000 work hours | $34.02 | $42.88 | $51.74
2,001-3,000 work hours | $34.98 | $44.32 | $53.66
3,001-4,000 work hours | $36.91 | $47.21 | $57.52

Class II - Manhole, headwall, catch basin builder, bricklayer tender, mortar man, material mixer, fence erector, and guard rail builder.

Apprentice Rates:
0-1,000 work hours | $33.14 | $41.56 | $49.98
1,001-2,000 work hours | $34.10 | $43.00 | $51.90
2,001-3,000 work hours | $35.07 | $44.45 | $53.84
3,001-4,000 work hours | $37.01 | $47.37 | $57.72

Official Request #: 150
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County: Wayne

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## Official 2015 Prevailing Wage Rates for State Funded Projects

### Issue Date: 2/5/2015

**Contract must be awarded by:** 5/6/2015

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<table>
<thead>
<tr>
<th>Classification</th>
<th>Name Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half Hourly</th>
<th>Double Time</th>
<th>Overtime Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class III - Air tool operator (jack hammer man, bush hammer man and grinding man), first bottom man, second bottom man, cage tender, car pusher, carrier man, concrete man, concrete form man, concrete repair man, cement invert laborer, cement finisher, concrete shoveler, conveyor man, floor man, gasoline and electric tool operator, gunnite man, grout operator, welder, heading dinky man, inside lock tender, pea gravel operator, pump man, outside lock tender, scaffold man, top signal man, switch man, track man, tugger man, utility man, vibrator man, winch operator, pipe jacking man, wagon drill and air track operator and concrete saw operator (under 40 h.p.)</td>
<td>LAUCT-Z1-3 9/6/2013</td>
<td>$38.04</td>
<td>$48.91</td>
<td>$59.78</td>
<td>X X X X X X</td>
</tr>
<tr>
<td>Class IV - Tunnel, shaft and caisson mucker, bracer man, liner plate man, long haul dinky driver and well point man.</td>
<td>LAUCT-Z1-4 9/6/2013</td>
<td>$38.22</td>
<td>$49.18</td>
<td>$60.14</td>
<td>X X X X X X</td>
</tr>
<tr>
<td><strong>Apprentice Rates:</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>0-1,000 work hours</td>
<td>$33.18</td>
<td>$41.62</td>
<td>$50.06</td>
<td></td>
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</tr>
<tr>
<td>1,001-2,000 work hours</td>
<td>$34.15</td>
<td>$43.07</td>
<td>$52.00</td>
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<tr>
<td>2,001-3,000 work hours</td>
<td>$35.12</td>
<td>$44.53</td>
<td>$53.94</td>
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<tr>
<td>3,001-4,000 work hours</td>
<td>$37.07</td>
<td>$47.45</td>
<td>$57.84</td>
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<td><strong>Apprentice Rates:</strong></td>
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<tr>
<td>0-1,000 work hours</td>
<td>$33.32</td>
<td>$41.83</td>
<td>$50.34</td>
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<td>1,001-2,000 work hours</td>
<td>$34.30</td>
<td>$43.30</td>
<td>$52.30</td>
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<tr>
<td>2,001-3,000 work hours</td>
<td>$35.28</td>
<td>$44.71</td>
<td>$54.26</td>
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<tr>
<td>3,001-4,000 work hours</td>
<td>$37.24</td>
<td>$47.71</td>
<td>$58.18</td>
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**Official Request #: 150**
Requestor: Wayne State University
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof

**Project Number: 130-252650**
County: Wayne

**Official Rate Schedule**
Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.

Page 14 of 33
### Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015  
**Page 15 of 33**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half Hourly Provision</th>
<th>Double Time Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class V</td>
<td>Tunnel, shaft and caisson miner, drill runner, keyboard operator, power knife operator, reinforced steel or mesh man (e.g. wire mesh, steel mats, dowel bars)</td>
<td>9/6/2013</td>
<td>$38.47</td>
<td>$49.56</td>
</tr>
</tbody>
</table>

**Apprentice Rates:**

- 0-1,000 work hours: $33.50, $42.10, $50.70
- 1,001-2,000 work hours: $34.50, $43.60, $52.70
- 2,001-3,000 work hours: $35.49, $45.09, $54.68
- 3,001-4,000 work hours: $37.48, $48.07, $58.66

Class VI - Dynamite man and powder man.

LAUCT-Z1-6 9/6/2013  

$38.80, $50.05, $61.30  

**Apprentice Rates:**

- 0-1,000 work hours: $33.75, $42.47, $51.20
- 1,001-2,000 work hours: $34.76, $43.99, $53.22
- 2,001-3,000 work hours: $35.77, $45.51, $55.24
- 3,001-4,000 work hours: $37.79, $48.53, $59.28

Class VII - Restoration laborer, seeding, sodding, planting, cutting, mulching and topsoil grading and the restoration of property such as replacing mail boxes, wood chips, planter boxes and flagstones.

LAUCT-Z1-7 9/6/2013  

$32.08, $39.97, $47.86  

**Apprentice Rates:**

- 0-1,000 work hours: $28.71, $34.91, $41.12
- 1,001-2,000 work hours: $29.38, $35.92, $42.46
- 2,001-3,000 work hours: $30.06, $36.94, $43.82
- 3,001-4,000 work hours: $31.41, $38.97, $46.52

---

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### Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
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#### Landscape Laborer

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half Time Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscape Laborer</td>
<td>Landscape Specialist includes air, gas, and diesel equipment operator, skidsteer (or equivalent), lawn sprinkler installer on landscaping work where seeding, sodding, planting, cutting, trimming, backfilling, rough grading or maintenance of landscape projects occurs.</td>
<td>6/26/2014</td>
<td>$28.58 $39.49 X X H X X H D Y</td>
</tr>
</tbody>
</table>

Sundays paid at time & one half. Holidays paid at double time.

#### Skilled Landscape Laborer: small power tool operator, lawn sprinkler installers' tender, material mover, truck driver when seeding, sodding, planting, cutting, trimming, backfilling, rough grading or maintaining of landscape projects occurs.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half Time Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscape Laborer</td>
<td>Skilled Landscape Laborer: small power tool operator, lawn sprinkler installers' tender, material mover, truck driver when seeding, sodding, planting, cutting, trimming, backfilling, rough grading or maintaining of landscape projects occurs.</td>
<td>6/26/2014</td>
<td>$24.36 $33.16 X X H X X H D Y</td>
</tr>
</tbody>
</table>

Sundays paid at time & one half. Holidays paid at double time.

#### Marble Finisher

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half Time Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marble Finisher</td>
<td>A 4 ten workweek may be worked Monday thru Thursday or Tuesday thru Friday.</td>
<td>10/20/2014</td>
<td>$43.48 $54.29 H H D H D D D Y</td>
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</table>

<table>
<thead>
<tr>
<th>Apprentice Rates:</th>
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</thead>
<tbody>
<tr>
<td>Level 1</td>
</tr>
<tr>
<td>Level 2</td>
</tr>
<tr>
<td>Level 3</td>
</tr>
<tr>
<td>Level 4</td>
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<td>Level 5</td>
</tr>
<tr>
<td>Level 6</td>
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<tr>
<td>Level 7</td>
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<td>Level 8</td>
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**Official Request #: 150**  
Requestor: Wayne State University  
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof  
Project Number: 130-252650  
County: Wayne  

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Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015

**Contract must be awarded by:** 5/6/2015

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<table>
<thead>
<tr>
<th>Classification</th>
<th>Name Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half</th>
<th>Double Time</th>
<th>Overtime Provision</th>
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</thead>
<tbody>
<tr>
<td>Marble Mason</td>
<td>Marble Mason</td>
<td>10/17/2014</td>
<td>$50.29</td>
<td>$64.51</td>
<td>H H D D D D D Y</td>
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</table>

A 4 ten workweek may be worked Monday thru Thursday or Tuesday thru Friday.

**Apprentice Rates:**

<table>
<thead>
<tr>
<th>Level</th>
<th>Straight Time</th>
<th>Half</th>
<th>Double Time</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>$25.14</td>
<td>$32.65</td>
<td>$40.15</td>
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<tr>
<td>2</td>
<td>$28.20</td>
<td>$36.49</td>
<td>$44.78</td>
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<td>3</td>
<td>$33.41</td>
<td>$41.97</td>
<td>$50.53</td>
</tr>
<tr>
<td>4</td>
<td>$36.15</td>
<td>$45.66</td>
<td>$55.17</td>
</tr>
<tr>
<td>5</td>
<td>$38.42</td>
<td>$48.17</td>
<td>$57.92</td>
</tr>
<tr>
<td>6</td>
<td>$42.07</td>
<td>$53.56</td>
<td>$65.05</td>
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<tr>
<td>7</td>
<td>$42.74</td>
<td>$54.38</td>
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</tr>
<tr>
<td>8</td>
<td>$43.67</td>
<td>$55.78</td>
<td>$67.88</td>
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</table>

**Operating Engineer**

| Crane with boom & jib or leads 120' or longer | EN-324-A120 6/12/2014 | $57.11 | $74.62 | $92.13 X X H D D D D Y |
| Double time after 12 hours M-F |

| Crane with boom & jib or leads 140' or longer | EN-324-A140 6/12/2014 | $57.93 | $75.85 | $93.77 X X H D D D D Y |
| Work in excess of 12 per day M-F shall be paid at double time. |

| Crane with boom & jib or leads 220' or longer | EN-324-A220 6/12/2014 | $58.23 | $76.30 | $94.37 X X H D D D D Y |
| Work in excess of 12 per day M-F shall be paid at double time. |

| Crane with boom & jib or leads 300' or longer | EN-324-A300 6/12/2014 | $59.73 | $78.55 | $97.37 X X H D D D D Y |
| Work in excess of 12 per day M-F shall be paid at double time. |
Official 2015 Prevailing Wage Rates for State Funded Projects

Issue Date: 2/5/2015
Contract must be awarded by: 5/6/2015

Page 18 of 33

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name</th>
<th>Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half</th>
<th>Double Time</th>
<th>Overtime Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN-324-A400</td>
<td>Crane with boom &amp; jib or leads 400' or longer</td>
<td>Work in excess of 12 per day M-F shall be paid at double time.</td>
<td>6/12/2014</td>
<td>$61.23</td>
<td>$80.80</td>
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<tr>
<td>EN-324-CW</td>
<td>Compressor or welding machine</td>
<td>Work in excess of 12 per day M-F shall be paid at double time.</td>
<td>6/12/2014</td>
<td>$46.26</td>
<td>$58.35</td>
<td>$70.43</td>
</tr>
<tr>
<td>EN-324-FL</td>
<td>Forklift, lull, extend-a-boom forklift</td>
<td>Work in excess of 12 per day M-F shall be paid at double time.</td>
<td>6/12/2014</td>
<td>$53.57</td>
<td>$69.31</td>
<td>$85.05</td>
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<tr>
<td>EN-324-FO</td>
<td>Fireman or oiler</td>
<td>Work in excess of 12 per day M-F shall be paid at double time.</td>
<td>6/12/2014</td>
<td>$45.23</td>
<td>$56.80</td>
<td>$68.37</td>
</tr>
<tr>
<td>EN-324-RC</td>
<td>Regular crane, job mechanic, concrete pump with boom</td>
<td>Work in excess of 12 per day M-F shall be paid at double time.</td>
<td>6/12/2014</td>
<td>$56.25</td>
<td>$73.33</td>
<td>$90.41</td>
</tr>
<tr>
<td>EN-324-RE</td>
<td>Regular engineer, hydro-excavator, remote controlled concrete breaker</td>
<td>Work in excess of 12 per day M-F shall be paid at double time.</td>
<td>6/12/2014</td>
<td>$55.28</td>
<td>$71.88</td>
<td>$88.47</td>
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Apprentice Rates:

<table>
<thead>
<tr>
<th>Hours</th>
<th>Straight Time</th>
<th>Half Day</th>
<th>Double Time</th>
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<tr>
<td>0-999 hours</td>
<td>$44.32</td>
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<tr>
<td>1,000-1,999 hours</td>
<td>$45.99</td>
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<td>2,000-2,999 hours</td>
<td>$47.64</td>
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<td>3,000-3,999 hours</td>
<td>$49.30</td>
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</tr>
<tr>
<td>4,000-4,999 hours</td>
<td>$50.96</td>
<td>$65.90</td>
<td>$80.83</td>
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<tr>
<td>5,000-5,999 hours</td>
<td>$52.62</td>
<td>$68.39</td>
<td>$84.15</td>
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</tbody>
</table>

Official Rate Schedule

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## Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015

### Classification

<table>
<thead>
<tr>
<th>Name Description</th>
<th>Updated</th>
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<th>Straight Time and a Half Hourly</th>
<th>Double Time</th>
<th>Overtime Provision</th>
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<tbody>
<tr>
<td>Operating Engineer - DIVER</td>
<td>GLF D</td>
<td>4/2/2014</td>
<td>$52.80 $79.20 $105.60 H H H H H D N</td>
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<tr>
<td>Operating Engineer - Marine Construction</td>
<td>GLF-1</td>
<td>2/12/2014</td>
<td>$65.00 $84.85 $104.70 X X H H H H D Y</td>
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<tr>
<td>Make up day allowed</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Subdivision of county</td>
<td>All Great Lakes, islands therein, &amp; connecting &amp; tributary waters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crane/Backhoe Operator, 70 ton or over Tug, Operator, Mechanic/Welder, Assistant Engineer (hydraulic dredge), Leverman (hydraulic dredge), Diver Tender</td>
<td>GLF-2</td>
<td>2/12/2014</td>
<td>$63.50 $82.60 $101.70 X X H H H H D Y</td>
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<tr>
<td>Holiday pay = $120.80 per hour, wages &amp; Make up day allowed</td>
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<td></td>
<td></td>
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<tr>
<td>Subdivision of county</td>
<td>All Great Lakes, islands therein, &amp; connecting &amp; tributary waters</td>
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<td></td>
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<tr>
<td>Friction, Lattice Boom or Crane License Certification</td>
<td>GLF-2B</td>
<td>2/12/2014</td>
<td>$64.50 $84.10 $103.70 X X H H H H D Y</td>
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<tr>
<td>Holiday pay = $123.30 Make up day allowed</td>
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<tr>
<td>Subdivision of county</td>
<td>All Great Lakes, islands therein, &amp; connecting &amp; tributary waters</td>
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<tr>
<td>Deck Equipment Operator, Machineryman, Maintenance of Crane (over 50 ton capacity) or Backhoe (115,000 lbs or more), Tug/Launch Operator, Loader, Dozer on Barge, Deck Machinery</td>
<td>GLF-3</td>
<td>2/12/2014</td>
<td>$59.30 $76.30 $93.30 X X H H H H D Y</td>
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<tr>
<td>Holiday pay = $110.30 per hour, wages &amp; Make up day allowed</td>
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<tr>
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Official Request #: 150  
Requestor: Wayne State University  
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof  
Project Number: 130-252650  
County: Statewide

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### Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
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#### Page 20 of 33

<table>
<thead>
<tr>
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<th>Straight Time and a Half Hourly Provision</th>
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<th>Overtime Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deck Equipment Operator, (Machineman/Fireman), (4 equipment units or more), Off Road Trucks, Deck Hand, Tug Engineer, &amp; Crane Maintenance 50 ton capacity and under or Backhoe 115,000 lbs or less, Assistant Tug Operator</td>
<td>GLF-4 2/12/2014</td>
<td>$53.60</td>
<td>$67.75</td>
<td>$81.90</td>
<td>X X H H H H D Y</td>
</tr>
<tr>
<td>Holiday pay = $96.05 per hour, wages &amp; fringes</td>
<td>Make up day allowed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Subdivision of county**  
All Great Lakes, islands therein, & connecting & tributary waters

#### Operating Engineer Steel Work

<table>
<thead>
<tr>
<th>Name Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half Hourly Provision</th>
<th>Double Time Provision</th>
<th>Overtime Provision</th>
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</thead>
<tbody>
<tr>
<td>Forklift, 1 Drum Hoist</td>
<td>EN-324-en 9/5/2014</td>
<td>$58.16</td>
<td>$76.37</td>
<td>$94.58</td>
</tr>
<tr>
<td>Make up day allowed</td>
<td>comment</td>
<td>4 10s allowed M-Th with Friday makeup day because of bad weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crane w/ 120’ boom or longer</td>
<td>EN-324-SW120 9/5/2014</td>
<td>$60.86</td>
<td>$80.42</td>
<td>$99.98</td>
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<tr>
<td>Make up day allowed</td>
<td>comment</td>
<td>4 10s allowed M-Th with Friday makeup day because of bad weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crane w/ 120’ boom or longer w/ Oiler</td>
<td>EN-324-SW120-O 9/5/2014</td>
<td>$61.86</td>
<td>$81.92</td>
<td>$101.98</td>
</tr>
<tr>
<td>Make up day allowed</td>
<td>comment</td>
<td>4 10s allowed M-Th with Friday makeup day because of bad weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crane w/ 140’ boom or longer</td>
<td>EN-324-SW140 9/5/2014</td>
<td>$62.04</td>
<td>$82.19</td>
<td>$102.34</td>
</tr>
<tr>
<td>Make up day allowed</td>
<td>comment</td>
<td>4 10s allowed M-Th with Friday makeup day because of bad weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crane w/ 140’ boom or longer W/ Oiler</td>
<td>EN-324-SW140-O 9/5/2014</td>
<td>$63.04</td>
<td>$83.69</td>
<td>$104.34</td>
</tr>
<tr>
<td>Make up day allowed</td>
<td>comment</td>
<td>4 10s allowed M-Th with Friday makeup day because of bad weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boom &amp; Jib 220’ or longer</td>
<td>EN-324-SW220 9/5/2014</td>
<td>$62.31</td>
<td>$82.60</td>
<td>$102.88</td>
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<td>comment</td>
<td>4 10s allowed M-Th with Friday makeup day because of bad weather</td>
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<td>Crane w/ 220’ boom or longer w/ Oiler</td>
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<td>$63.31</td>
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<td>comment</td>
<td>4 10s allowed M-Th with Friday makeup day because of bad weather</td>
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<td></td>
</tr>
</tbody>
</table>

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**Official Request #: 150**  
**Requestor:** Wayne State University  
**Project Description:** Install Roof Top Units, Upgrade Control System & Repair Roof  
**Project Number:** 130-252650  
**County:** Wayne

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---

**Page 20 of 33**
# Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015  
**Page 21 of 33**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Name</th>
<th>Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half Hourly</th>
<th>Double Time</th>
<th>Overtime Provision</th>
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<tbody>
<tr>
<td>Boom &amp; Jib 300' or longer</td>
<td>EN-324-SW300</td>
<td>9/5/2014</td>
<td>$63.81</td>
<td>$84.85</td>
<td>$105.88 H H D H H D D Y</td>
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<tr>
<td>Crane w/ 300' boom or longer w/ Oiler</td>
<td>EN-324-SW300-O</td>
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<td>$64.81</td>
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<td>Compressor or Welder Operator</td>
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**Official Request #: 150**  
**Requestor:** Wayne State University  
**Project Description:** Install Roof Top Units, Upgrade Control System & Repair Roof  
**Project Number:** 130-252650  
**County:** Wayne
### Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015  
**Page 22 of 33**

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<thead>
<tr>
<th>Classification</th>
<th>Name Description</th>
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<th>Straight Time and a Half</th>
<th>Double Time</th>
<th>Overtime Provision</th>
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<tbody>
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<td>Hoisting Operator, 2 Drum Hoist, &amp; Rubber Tire Backhoe</td>
<td>EN-324-SWHO 9/5/2014</td>
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<td>Tower Crane &amp; Derrick where work is 50' or more above first level</td>
<td>EN-324-SWTD50 9/5/2014</td>
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<td>Tower Crane &amp; Derrick 50' or more w/ Oiler where work station is 50' or more above first level</td>
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<td>Operating Engineer Underground</td>
<td>EN-324A1-UC1 10/14/2014</td>
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<td>Class I Equipment</td>
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</table>

Official Request #: 150  
Requestor: Wayne State University  
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof  
Project Number: 130-252650  
County: Wayne  

Official Rate Schedule  
Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.

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Official 2015 Prevailing Wage Rates for State Funded Projects

Issue Date: 2/5/2015
Contract must be awarded by: 5/6/2015

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<th>Double Time</th>
<th>Overtime Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class IV Equipment</td>
<td>EN-324A1-UC4</td>
<td>10/14/2014</td>
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<td>Master Mechanic</td>
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<td>10/14/2014</td>
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<td>$67.81$83.63</td>
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<td>Painter</td>
<td>PT-22-P</td>
<td>10/8/2014</td>
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<td>Apprentice Rates:</td>
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<td>First 6 months</td>
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<td>Final 6 months</td>
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<td>$38.98</td>
<td>$49.87</td>
<td>$60.75</td>
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<tr>
<td>Pipe and Manhole Rehab</td>
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<tr>
<td>General Laborer for rehab work or normal cleaning and cctv work-top man, scaffold man, CCTV assistant, jetter-vac assistant</td>
<td>TM247</td>
<td>10/15/2012</td>
<td>$27.20</td>
<td>$36.70</td>
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<tr>
<td>Tap cutter/CCTV Tech/Grout Equipment</td>
<td>Operator: unit driver and operator of CCTV; grouting equipment and tap cutting equipment</td>
<td>TM247-2</td>
<td>10/15/2012</td>
<td>$31.70</td>
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</table>
## Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
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### Classification Table

<table>
<thead>
<tr>
<th>Name Description</th>
<th>Last Updated</th>
<th>Straight Time and a Half</th>
<th>Double Time</th>
<th>Overtime Provision</th>
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<tbody>
<tr>
<td>CCTV Technician/Combo Unit Operator: unit driver and operator of cctv unit or combo unit in connection with normal cleaning and televising work</td>
<td>TM247-3 10/15/2012</td>
<td>$30.45</td>
<td>$41.57</td>
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<tr>
<td>Boiler Operator: unit driver and operator of steam/water heater units and all ancillary equipment associated</td>
<td>TM247-4 10/15/2012</td>
<td>$32.20</td>
<td>$44.20</td>
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<tr>
<td>Combo Unit driver &amp; Jetter-Vac Operator</td>
<td>TM247-5 10/15/2012</td>
<td>$32.20</td>
<td>$44.20</td>
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<tr>
<td>Pipe Bursting &amp; Slip-lining Equipment Operator</td>
<td>TM247-6 10/15/2012</td>
<td>$33.20</td>
<td>$45.70</td>
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<td>Pipefitter</td>
<td>PF-636 6/30/2014</td>
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<td>$105.13</td>
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</table>

**comment**

Four 10s allowed during the week preceding, following and/or the week of a holiday.

### Apprentice Rates:

- 1st & 2nd periods: $26.93, $35.28, $42.28
- 3rd period: $28.93, $38.28, $46.28
- 4th period: $30.18, $40.16, $48.78
- 5th period: $31.43, $42.03, $51.28
- 6th period: $32.68, $43.90, $53.78
- 7th period: $33.93, $45.78, $56.28
- 8th period: $34.93, $47.28, $58.28
- 9th period: $35.93, $48.78, $60.28
- 10th period: $37.36, $50.92, $63.14

**Official Request #:** 150  
**Requestor:** Wayne State University  
**Project Description:** Install Rooftop Units, Upgrade Control System & Repair Roof  
**Project Number:** 130-252650  
**County:** Wayne

**Official Rate Schedule**

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## Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
**Contract must be awarded by:** 5/6/2015

### Classification Last Straight Time and a Double Overtime  Name Description Updated Hourly Half Time Provision

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<th>Last Updated</th>
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<th>Half Time</th>
<th>Double Time</th>
<th>Overtime Provision</th>
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**Apprentice Rates:**

- **1st 6 months**: $32.11   $48.17   $64.22
- **2nd 6 months**: $33.40   $50.10   $66.80
- **3rd 6 months**: $34.69   $52.04   $69.38
- **4th 6 months**: $37.28   $55.92   $74.56
- **5th 6 months**: $39.87   $59.81   $79.74
- **6th 6 months**: $42.45   $63.68   $84.90

Official Request #: 150  
Requestor: Wayne State University  
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof  
Project Number: 130-252650  
County: Wayne

Official Rate Schedule  
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### Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015  
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#### Official Request #: 150  
Requestor: Wayne State University  
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof  
Project Number: 130-252650  
County: Statewide

<table>
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<th>Straight Time and a Half Hourly</th>
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<th>Overtime Provision</th>
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<td>RO-149-WOM</td>
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<td>SR-1</td>
<td>Class I-Operator of audio visual CCTV system including remote in-ground cutter and other equipment used in conjunction with CCTV</td>
<td>11/3/2014</td>
<td>$42.76 $57.75 $72.74 H H H H H H D N</td>
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</table>

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<th>Half</th>
<th>Double</th>
<th>Overtime</th>
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<tr>
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<tr>
<td>Class II-Operator of hot water heaters and circulation system; water jetters; and vacuum and mechanical debris removal systems and those assisting.</td>
<td>SR-II</td>
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**Sheet Metal Worker**

Sheet Metal Worker  
SHM-80  
9/9/2014  
$61.83  
$78.74  
$95.65 | H | H | D | X | H | H | D | Y |

A 4 10 schedule may be worked, 4 consecutive days Monday thru Friday.

**Apprentice Rates:**

- 1st & 2nd Periods Indentured after 6-1-11  
  $39.18  
  $46.79  
  $54.40

- 3rd & 4th Periods Indentured after 6-1-11  
  $40.88  
  $49.34  
  $57.80

- 5th & 6th Periods Indentured after 6-1-11  
  $42.56  
  $51.86  
  $61.16

- 7th & 8th Periods Indentured after 6-1-11  
  $44.25  
  $54.40  
  $64.54

- 9th & 10th Periods Indentured before 6-1-11  
  $51.92  
  $64.44  
  $76.96

**Siding and decking**

SHM-80-SD  
1/13/2014  
$42.07  
$54.28  
$66.48 | H | H | H | H | H | D | Y |

Make up day allowed

---

**Official Request #:150**  
**Requestor:** Wayne State University  
**Project Description:** Install Roof Top Units, Upgrade Control System & Repair Roof  
**Project Number:** 130-252650  
**County:** Wayne

**Official Rate Schedule**

Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.
Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015

**Contract must be awarded by:** 5/6/2015

### Sprinkler Fitter
- Name: Sprinkler Fitter
- Description: SP 704
- Date Updated: 12/19/2014
- Hourly Rate: $64.92
- Half Time Provision: $86.15
- Double Time Provision: $107.38
- Overtime Provision: H H D H D D D Y

4 ten hour days allowed Monday-Friday

Double time pay due after 12 hours worked M-F

#### Apprentice Rates:

1st Period: $28.29  $36.78  $45.27
2nd Period: $41.57  $51.12  $60.68
3rd Period: $43.69  $54.30  $64.92
4th Period: $45.81  $57.48  $69.16
5th Period: $47.94  $60.68  $73.42
6th Period: $50.06  $63.86  $77.66
7th Period: $52.18  $67.04  $81.90
8th Period: $54.30  $70.22  $86.14
9th Period: $56.43  $73.42  $90.40
10th Period: $58.55  $76.60  $94.64

### Terrazzo
- Name: Terrazzo Finisher
- Description: BR1-TRF
- Date Updated: 10/17/2014
- Hourly Rate: $43.97
- Half Time Provision: $55.03
- Double Time Provision: $66.08
- Overtime Provision: H H D H D D D Y

A 4 ten workweek may be worked Monday thru Thursday or Tuesday thru Friday.

#### Apprentice Rates:

Level 1: $19.04  $25.12  $31.20
Level 2: $20.24  $26.92  $33.60
Level 3: $27.01  $33.96  $40.90
Level 4: $28.47  $36.14  $43.82
Level 5: $29.99  $37.84  $45.70
Level 6: $31.61  $39.86  $48.10
Level 7: $33.30  $41.59  $49.87
Level 8: $34.79  $43.48  $52.17
Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015
**Contract must be awarded by:** 5/6/2015

Page 29 of 33

<table>
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<td>$55.78</td>
<td>$67.88</td>
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</table>

**Tile Finisher**

| Description       | BR1-TF           | 10/17/2014   | $43.50                        | $54.32      | $65.14 H H D D D D Y |
|                  |                  |              |                               |             |                    |
| Apprentice Rates: |                  |              |                               |             |                    |
| Level 1         |                   |              | $19.04                        | $25.12      | $31.20             |
| Level 2         |                   |              | $20.24                        | $26.92      | $33.60             |
| Level 3         |                   |              | $27.01                        | $33.96      | $40.90             |
| Level 4         |                   |              | $28.47                        | $36.14      | $43.82             |
| Level 5         |                   |              | $29.99                        | $37.84      | $45.70             |
| Level 6         |                   |              | $31.61                        | $39.86      | $48.10             |
| Level 7         |                   |              | $33.30                        | $41.59      | $49.87             |
| Level 8         |                   |              | $34.79                        | $43.48      | $52.17             |

Official Request #: 150
Requestor: Wayne State University
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof

Official Rate Schedule
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Page 29 of 33
Official 2015 Prevailing Wage Rates for State Funded Projects

**Issue Date:** 2/5/2015
**Contract must be awarded by:** 5/6/2015

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<th>Classification</th>
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<th>Overtime Provision</th>
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<td>on all trucks of 8 cubic yard capacity or less (except dump trucks of 8 cubic yard capacity or over, tandem axle trucks, transit mix and semis, euclid type equipment, double bottoms and low boys)</td>
<td></td>
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<td></td>
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<td>of all trucks of 8 cubic yard capacity or over</td>
<td>TM-RB1A</td>
<td>8/8/2013</td>
<td>$41.30</td>
<td>$38.00</td>
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<td>on euclid type equipment</td>
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Make up day allowed

Official Request #:150
Requestor: Wayne State University
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof
Project Number: 130-252650
County: Wayne

Official Rate Schedule
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Page 30 of 33
### Underground Laborer Open Cut, Class I

**Construction Laborer**

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<tr>
<th>Last Updated</th>
<th>Straight Time and a Half</th>
<th>Double Time</th>
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<tbody>
<tr>
<td>9/5/2013</td>
<td>$37.72</td>
<td>$48.43</td>
<td>$59.14 X X X X X X</td>
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**Apprentice Rates:**

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<thead>
<tr>
<th>Work Hours Range</th>
<th>Hourly</th>
<th>Half Time</th>
<th>Double Time</th>
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<tbody>
<tr>
<td>0-1,000</td>
<td>$32.94</td>
<td>$41.26</td>
<td>$49.58</td>
</tr>
<tr>
<td>1,001-2,000</td>
<td>$33.90</td>
<td>$42.70</td>
<td>$51.50</td>
</tr>
<tr>
<td>2,001-3,000</td>
<td>$34.85</td>
<td>$44.13</td>
<td>$53.40</td>
</tr>
<tr>
<td>3,001-4,000</td>
<td>$36.76</td>
<td>$46.99</td>
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</table>

### Underground Laborer Open Cut, Class II

**Mortar and material mixer, concrete form man, signal man, well point man, manhole, headwall and catch basin builder, guard rail builders, headwall, seawall, breakwall, dock builder and fence erector.**

<table>
<thead>
<tr>
<th>Last Updated</th>
<th>Straight Time and a Half</th>
<th>Double Time</th>
<th>Overtime Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/25/2013</td>
<td>$37.83</td>
<td>$48.60</td>
<td>$59.36 X X X X X X</td>
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**Apprentice Rates:**

<table>
<thead>
<tr>
<th>Work Hours Range</th>
<th>Hourly</th>
<th>Half Time</th>
<th>Double Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1,000</td>
<td>$33.02</td>
<td>$41.38</td>
<td>$49.74</td>
</tr>
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<td>1,001-2,000</td>
<td>$33.98</td>
<td>$42.82</td>
<td>$51.66</td>
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<tr>
<td>2,001-3,000</td>
<td>$34.95</td>
<td>$44.27</td>
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<tr>
<td>3,001-4,000</td>
<td>$36.87</td>
<td>$47.15</td>
<td>$57.44</td>
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### Underground Laborer Open Cut, Class III

**Air, gasoline and electric tool operator, vibrator operator, drillers, pump man, tar kettle operator, bracers, rodder, reinforced steel or mesh man (e.g. wire mesh, steel mats, dowel bars, etc.), cement finisher, welder, pipe jacking and boring man, wagon drill and air track operator and concrete saw operator (under 40 h.p.), windlass and tugger man, and directional boring man.**

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<tr>
<td>9/5/2013</td>
<td>$37.88</td>
<td>$48.67</td>
<td>$59.46 X X X X X X</td>
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**Apprentice Rates:**

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## Official 2015 Prevailing Wage Rates for State Funded Projects

### Issue Date: 2/5/2015

### Contract must be awarded by: 5/6/2015

#### Page 32 of 33

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Official Request #: 150
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**Issue Date:** 2/5/2015  
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**Page 33 of 33**

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<th>Double Time Hourly</th>
<th>Overtime Provision</th>
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<td>Restoration laborer, seeding, sodding, planting, cutting, mulching and topsoil grading and the restoration of property such as replacing mail boxes, wood chips, planter boxes, flagstones etc.</td>
<td>LAUC-Z1-7</td>
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<td>$39.99</td>
<td>$47.88</td>
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### Apprentice Rates:

- **0-1,000 work hours**  
  - $28.72  
  - $34.93  
  - $41.14

- **1,001-2,000 work hours**  
  - $29.39  
  - $35.93  
  - $42.48

- **2,001-3,000 work hours**  
  - $30.07  
  - $36.95  
  - $43.84

- **3,001-4,000 work hours**  
  - $31.42  
  - $38.98  
  - $46.54

---

Official Request #:150  
Requestor: Wayne State University  
Project Description: Install Roof Top Units, Upgrade Control System & Repair Roof  
Project Number: 130-252650  
County: Wayne

Official Rate Schedule  
Every contractor and subcontractor shall keep posted on the construction site, in a conspicuous place, a copy of all prevailing wage and fringe benefit rates prescribed in a contract.
PAYMENT PACKAGE DOCUMENT REQUIREMENTS

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.

DEPT. of LABOR FORM WH-347 – Certified Payroll Checklist:

- 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.

APPLICATION PACKAGE SUPPORTING DOCUMENTATION – Must accompany all package reporting periods: (Union and Non-Union)

- Copies of Pay Stubs may be required for each Certified Payroll period reported – (Social Security Numbers MUST be blackened out or listed in XXX-XX-1234 format. Pay stubs need to reflect claimed participation of fringes like Medical, Dental, Retirement or 1099 classification.)
- Proof of Ownership for any "Owner Operator" (Sole Proprietor) contractors not claiming their time under prevailing wage act. – (Must list their hours and dates worked on the WH-347 Form and enter EXEMPT on the income brackets.). The Owner Operator must provide copies of “DBA” registration form confirming status as exempt from prevailing wage requirements.
- Proof of Stored Materials – (Detailed Bill of Sale, certificate of insurance or endorsement page specifically insuring the stored materials, pictures, when large value. WSU reserves the right to on site verification of material. Stored material must be separated from ordinary inventory and labeled for WSU project.)
o Partial Unconditional Waivers – Must release the accumulated amount paid for work and be immediately provided, or provided with the subsequent application for payment. Waivers shall be provided for contractors, sub-contractors, and suppliers listed on the Sworn Statements. (This is required at all tiers)

o Full Unconditional Waivers – Prime Contractor must deliver fully executed Full Unconditional Waiver upon receipt of final payment. Full Unconditional waivers may be required of sub-contractors and suppliers in advance of final Contractor payment on bonded projects. This requirement shall be determined on a project-by-project basis. Full Unconditional waivers shall be required in advance of or at the time of final payment on all non-bonded projects from all subcontractors and suppliers listed on Sworn Statements, or who have provided a notice of furnishing.

o Partial Conditional Waivers – The Contractor shall provide a Partial Conditional Waivers covering the entire amount of the application for payment. For non-bonded Projects – A partial conditional waiver from all subcontractors must accompany any application for payment within which a subcontractor draw is included.

o Sworn Statements – Required for all Sub Contractors, and Sub-subcontractors (etc.) with any contracts or purchases exceeding $1,000.

**FINAL PAYMENT EXCHANGE – Checklist:**

- Clear and concise As-Built drawings.
- Operation and Maintenance Manuals.
- Required training must be completed (if applicable).
- Warranty of work in accordance with project documents.
- Certificate of Substantial Completion.
- Full Unconditional Waiver

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

Revised 5-6-2011
AGREEMENT BETWEEN THE UNIVERSITY AND CONTRACTOR
FOR CONSTRUCTION SERVICES (rev 6-2013)

Executed as of the _____ day of __________, 2014 by and between:

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

and

CONTRACTOR’S_NAME
CONTRACTOR’S_ADDRESS

regarding

FAB Roof Top Units Replacement Re-Bid 2015
656 West Kirby Avenue, Detroit, MI 48202
WSU Project No. 130-252650-4
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 **Install RTU, upgrade control system and repair roof insulation** located at **656 West Kirby Avenue, Detroit, MI 48202**. 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 18, 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**

2.1 The work to be performed under this Agreement shall commence upon the Contractor’s receipt of a fully-executed Agreement, and substantial completion shall be achieved by **May 15, 2015**.

**Article 3 - The Contract Sum**

3.1 The University shall pay the Contractor a “lump sum/not-to-exceed (pick one)” amount of $$$$$$$ (“Amount in words 00” /100 dollars) for the performance of all work associated with the Contractor’s Base Bid "and Alternates (List)".

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)*

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternate #1</td>
<td></td>
</tr>
<tr>
<td>Alternate #2</td>
<td></td>
</tr>
<tr>
<td>Alternate #3</td>
<td></td>
</tr>
</tbody>
</table>

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)*

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Unit Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>

**Article 4 - The Contract Documents**

4.1 The Contract Documents shall consist of this Agreement, the drawings and specifications as listed in Article 18, 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:

"(List the Architect and Engineer separately if appropriate)"

DiClemente Siegel Design Inc.
28105 Greenfield Road
Southfield, MI 48076

(Architect Phone No / Fax No)

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 superseded by this Article.

8.2 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.

8.3 For purposes of this section, the "end of negotiations" shall be deemed to have occurred when:

8.3.1 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
Wayne State University
FAB Roof Top Units Replacement Re-Bid 2015
WSU Project No. 130-252650-4

Agreement between Contractor and Owner 00500 - 5
For Construction

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 - Laborers and Mechanics

13.1 All laborers and mechanics must be covered by Worker's Compensation and Employer's Liability Insurance as required by Federal and Michigan law. The Contractor shall also require all of its Subcontractors to maintain this insurance coverage.

13.2 The Contractor acknowledges and shall abide by the University’s prohibition on use of 1099 independent contractors and owner / operator business entities. The Contractor shall ensure that all classifications of laborers and construction mechanics performing Work on the Project job site are employees of the Contractor or any Trade Contractor for any tier thereof, and that each worker is covered by workers compensation insurance.

Article 14 - Prevailing Wages

14.1 The Contractor and each subcontractor shall pay to each class of mechanics and laborers not less than the wage and fringe benefit rates prevailing in the Detroit Metropolitan Area, as determined by the United States Department of Labor. The Contractor shall post on site, in a conspicuous place, a copy of all applicable wage and benefit rates, and shall provide the University with a copy of the applicable wage and benefit rates.

14.2 The Contractor and each subcontractor shall keep an accurate record showing the name and occupation of and the actual benefits and wages paid to each laborer and mechanic employed in connection with this contract. The Contractor and each subcontractor shall make certified payroll records available to the University's representatives upon request.

14.3 If a Contractor or subcontractor fails to pay the prevailing rates of wages and fringe benefits 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:

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

14.3.2 Terminate part or all of this Agreement or any subagreement and proceed to complete the
Agreement or subagreement 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.

14.4 The Contractor shall include terms identical or substantially similar to this section in any Agreement or subagreement pertaining to the project.

**Article 15 - Save Harmless**

15.1 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 16 - Liquidated Damages**

16.1 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 $500.00, Five Hundred Dollars per day. Therefore, the Contractor shall pay as liquidated damages to the University the sum of $500.00, Five 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 thereunder.

"ENTER N/A FOR ABOVE AMOUNT IF NO LIQUIDATED DAMAGES"

**Article 17 - Interpretation**

17.1 This Agreement shall be interpreted and construed according to the laws of the State of Michigan.

17.2 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 18 - Drawings and Specifications**

18.1 The Technical Specifications and the Project Manual dated **February 9, 2015**), and the following List of Drawings represents the scope of work as defined in the Contract Documents from Article 4.

**DRAWINGS**

<table>
<thead>
<tr>
<th>Drawing No.:</th>
<th>Description</th>
<th>dated</th>
</tr>
</thead>
</table>
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 06/13 – LG

File_reference_here
FORM OF GUARANTEE

PROJECT:   FAB Roof Top Units Replacement Re-Bid 2015

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:

FAB Roof Top Units Replacement Re-Bid 2015 (130-252650-4)

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
Procurement & Strategic Sourcing
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; observe, 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.

c. 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 special cases the Owner may approve.

9.6 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

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

B. Maximum Acceptable Deductibles

<table>
<thead>
<tr>
<th>Type of Insurance</th>
<th>Maximum Deductible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehensive General Liability</td>
<td>$5,000</td>
</tr>
<tr>
<td>Fire Legal Liability</td>
<td>$5,000</td>
</tr>
<tr>
<td>Comprehensive Automobile Liability</td>
<td>-0-</td>
</tr>
<tr>
<td>Workers’ Compensation</td>
<td>-0-</td>
</tr>
<tr>
<td>Property - All Risk</td>
<td>$500</td>
</tr>
</tbody>
</table>

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 contractor 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 PREVAILING WAGES

15.4.1 Contractors and subcontractors shall pay all mechanics and laborers, including apprentices and trainees, no less than the wage and fringe benefit rates prevailing in the locality in which the work is performed. Wage and fringe benefit rates are determined by the Federal Government Department of Labor.

15.4.2 Classifications not provided in the schedule shall be determined prior to the award of the contract and shall be no less than the wage and fringe benefit rates determined by the Federal Department of Labor.

15.4.3 Contractors and subcontractors shall adhere to the ratios of apprentices to journey workers as determined by the Federal Department of Labor.

15.4.4 Contractors and subcontractors shall keep a copy of the prescribed wage and benefit rates posted at the construction site in a conspicuous place.
15.4.5 Contractors and subcontractors shall keep an accurate record of the name, occupation, and the actual benefits paid to each mechanic or laborer for the contract. This record shall be made available for reasonable inspection by the Federal Department of Labor and the Owner.
The Technical Specifications dated **February 9, 2015** and the following List of Drawings represent the scope of work as defined in the Contract Documents from Article 4.

<table>
<thead>
<tr>
<th>Drawing No.:</th>
<th>Description</th>
</tr>
</thead>
</table>
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 flameproofed.

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 Builts", 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.


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 backcharge 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

PROJECT: FAB Roof Top Units Replacement Re-Bid 2015

WSU PROJECT NO.: 130-252650-4

PROJECT MANAGER: Omar Alhyari

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 Replace the existing four roof top units one at a time with new structural steel, repair the roof below and around the new units, new roofing over the structural steel and upgrade the control system.

3. The building is located at

   Wayne State University
   656 West Kirby Avenue, Detroit, MI 48202
   Detroit, Michigan 48202
Wayne State University

WSU FAB Building
Rooftop Air Conditioning Replacement
5200 Anthony Wayne Drive
Detroit, MI

WSU Project Number 130-252650

SPECIFICATIONS

DSD Project No. 14-4802.00
SECTION 024119 - SELECTIVE 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 Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

C. 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 QUALITY ASSURANCE

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

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. 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 and preconstruction photographs.

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. Owner will arrange to shut off indicated services/systems when requested by Contractor.
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.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

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.

B. 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.

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

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner’s property, remove demolished materials from Project site.

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 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Grout.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication of structural-steel components.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, testing agency.
B. Welding certificates.
C. Mill test reports for structural steel, including chemical and physical properties.
D. Source quality-control reports.
E. Field quality-control and special inspection reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
D. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.

2.2 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

2.4 PRIMER

A. Primer: Fabricator’s standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer and compatible with topcoat.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, “Code of Standard Practice for Steel Buildings and Bridges,” and to AISC 360.
2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces to be field welded.
   2. Surfaces of high-strength bolted, slip-critical connections.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning."
   2. SSPC-SP 3, "Power Tool Cleaning."
   3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   4. Radiographic Inspection: ASTM E 94.

D. Prepare test and inspection reports.
PART 3 - EXECUTION

3.1 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

3.2 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC’s "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
   1. Verify structural-steel materials and inspect steel frame joint details.
   2. Verify weld materials and inspect welds.
   3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.

END OF SECTION 051200
SECTION 075323 - FULLY ADHERED EPDM ROOFING SYSTEM (0.060 Mil; 20-Year Warranty)

PART 1 - GENERAL

1.1 GENERAL NOTES

A. Preceding job start up, contractor shall decide to his satisfaction that all specifications contained herein are workable.

B. Contractor will perform all work by competent, trained, and properly equipped personnel in strict accordance with good roofing practices and applicable industry standards.

C. Contractor will observe all published safety prevention policies and practices relating to application of roofing system and related work. All federal, state, and local codes shall be followed.

D. Contractor will follow application, safety, etc. information as published in the most current edition of the Firestone RubberGard EPDM Roofing System Technical Specifications.

1.2 WORK INCLUDED

A. Work under this section covers the installation of a new Fully Adhered EPDM roofing system. In addition, contractor shall include all related items of work as noted herein or indicated on the drawings or otherwise required to complete the specified elements of work and provide the necessary warranties for this work.

B. Contractor will dispose of all materials properly. Any asbestos removal shall comply with state and local codes and requirements and shall be disposed of in a legal manner.

C. Below each roof top unit, within the curb and above the roofing insulation, the contractor shall include 3 layers of 3/4” continuous gypsum board green board, approved for damp locations with staggered joints for sound transmission reduction. Joints do not require taping or mudding.

1.3 SECTION INCLUDES

A. Substrate preparation.

B. Wood nailer installation.

C. Membrane installation.

D. Membrane flashing installation.

1.4 SYSTEM DESCRIPTION

A. .060 non-reinforced elastomeric sheet roofing that is adhered to acceptable substrate with system manufacture’s bonding adhesive.

1.5 SUBMITTALS

DSD PROJECT No. 14-4802.00
A. Product Data:

1. Submit copies of Firestone Technical Information Sheets (TIS) for all products used on this project.
2. Submit copies of Firestone Material Safety Data Sheets (MSDS) for all products used on this project.

B. Warranty: Submit warranty sample.

C. Pre Installation Notice:

1. Submit copy of Firestone Pre Installation Notice (PIN) that has been accepted and approved by Firestone.

D. Drawings:

1. Submit manufacturers shop drawing for tapered insulation.
   a. Shop drawings shall show complete layout of the tapered system and shall comply with the drainage patterns required. Only the manufacturer’s tapered insulation shop drawings will be acceptable.

1) The responsibility of providing shop drawings for this project lies solely with the manufacturer of the tapered insulation system. Shop drawings by others will not be acceptable.

2) Shop drawings shall include: Outline of roof, location of drains, scuppers or gutters, profile of tapered insulation components, indications of minimum and maximum insulation thicknesses, and the average “R” value for the completed insulation system.

3) The roofing contractor shall verify all roof dimensions and drain locations and confirm same with the manufacturer.

4) Approved shop drawings shall be returned to the manufacturer before insulation is delivered to the jobsite.

1.6 QUALITY ASSURANCE

A. Manufacturer:

1. Company specializing in manufacturing the roofing membrane specified in this Section with ten years of manufacturing experience.
2. System supplier must have ISO 9002 certification.
3. Manufacturer must be able to provide the project with the membrane and Isocyanurate insulation that is produced in their facilities.

B. Applicator:

1. Shall be approved, licensed, or authorized applicator of the manufacturer.
2. Shall be a Firestone Red Shield Licensed Contractor.
3. Shall be a current Firestone Partners in Quality Contractor.
4. Shall be a current red Shield Licensed contractor who has achieved Master Contractor status at least once in the last three years.
5. Shall be a current Firestone Master Contractor.
6. Shall have a fully staffed office within 100 miles of the job site.
7. Shall have at least five years experience in installing specified system.
8. Shall provide payment and performance bond to building owner.
9. Shall provide a payment performance bond.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable local building code requirements. Underwriters Laboratories, Inc. (UL): Class (A) Fire Hazard Classification.

B. Factory Mutual Corporation (FM): Roof Assembly Classification, FM Construction Bulletin 1-28, and 1-29 meeting minimum requirements of FM (1-90).

1.8 QUALITY INSPECTION/OBSERVATION

A. Inspection by Manufacturer: Provide a final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer.
   1. Technical representative shall not perform any sales functions.
   2. Contractor shall complete any necessary repairs required for issuance of warranty.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer’s original containers dry, undamaged, seals and labels intact and legible.

B. Store all materials clear of ground and moisture with weather protective covering.

C. Keep all combustible materials away from ALL ignition sources.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Install roofing membrane only when surfaces are clean, dry, smooth and free of snow or ice.

B. Do not apply roofing membrane during inclement weather or when ambient conditions will not allow proper application. Consult Firestone Technical Specifications on cold weather application.

1.11 WARRANTY

A. Type/Term:
   1. Provide (20) year Firestone Red Shield Roofing System Limited Warranty (Red Shield Warranty). Warranty shall include membrane, roof insulation and membrane accessories.

B. Coverage
   1. Red Shield Warranty:
      a. Limit of liability: No Dollar Limitation
      b. Scope of coverage:
          Repair any leak in the Firestone EPDM Roofing System caused by the ordinary wear and tear of the elements, manufacturing defect in Firestone brand materials, and the workmanship used to install these materials.

PART 2 - PRODUCTS

DSD PROJECT No. 14-4802.00
2.1 NAILERS FOR FLANGES AND ROOF ACCESSORIES

A. Description: Structural Grade No. 2 or better Southern Pine, Douglas Fir or Exterior Grade plywood. All wood shall be pressure treated for rot resistance.

1. Nailer width: Minimum 3-1/2 in. (nominal) wide or as wide as the nailing flange of each roof accessory.

2.2 MANUFACTURERS - MEMBRANE MATERIALS

A. Firestone Adhered single-ply membrane system: .060 LSFR elastomeric sheet roofing that is adhered to acceptable substrate with manufacturers bonding adhesive.

B. Approved Equals: None

2.3 ELASTOMERIC SHEET ROOFING AND FLASHING MEMBRANE

A. Description: Non-reinforced, cured, synthetic single-ply membrane composed of Ethylene Propylene Diene Termolymer (EPDM) conforming to the following physical properties:

1. Membrane Type: .060 LSFR

B. Product/Producer:

1. RubberGard® EPDM membrane by Firestone.

2.4 INSULATION PRODUCTS

POLYSOCYANURATE ROOF INSULATION

A. Description: Roof insulation consisting of closed cell polyisocyanurate foam core and a perforated black glass reinforced mat laminated to the face.

1. Thickness: 3.5” ISO (TO MATCH EXISTING)
2. Nominal Size 48 in x 96 in

B. Reference Standards:

5. ASTM D 1621 - Compressive Strength.
6. ASTM D 1622 - Density
7. ASTM D 2126 - Dimensional Stability.
8. ASTM E 84 - Flame Spread.

C. Product/Producer: ISO 95+ Polyisocyanurate Insulation by Firestone.

INSULATION FASTENERS

1. Description: Heavy duty threaded fastener with 3-coat waterborne fluorocarbon polymer coating and drill point tip capable of penetrating 20 gauge steel. Fastener shall meet
minimum thread size of .260" and a 13 threads per inch. Length shall be sufficient to penetrate deck a minimum of ¾" for steel and 1" for wood and concrete. Structural concrete decks must be pre-drilled with a 7/32" carbide drill bit to a depth ½" deeper than the fastener engagement.

2. Reference Standard: SAE 1022, Heat Treated
3. Product/Producer:
   a. Heavy Duty (HD) fasteners by Firestone.

2.5 ELASTOMERIC SHEET ROOFING SYSTEM COMPONENTS

A. Roof Flashing (Gravel Stops):
   1. Description: Semi-cured 45 mil EPDM membrane laminated to 35 mil EPDM tape adhesive
   2. Product/Producer:
      a. QuickSeam™ Flashing by Firestone.

B. Lap Splice Tape:
   1. Description: 35 mil EPDM-based, formulated for compatibility with EPDM membrane and high-solids primer.
   2. Product/Producer:
      a. QuickSeam™ Splice Tape by Firestone.

C. Adhesive Primer:
   1. Description: High-solids, butyl based primer formulated for compatibility with EPDM membrane & tape adhesive.
   2. Product/Producer:
      a. QuickPrime™ by Firestone.

D. Splice Adhesive:
   1. Description: Butyl-based, formulated for compatibility with EPDM membrane.
   2. Product/Producer:
      a. RubberGard® Splice Adhesive by Firestone.

E. Bonding Adhesive:
   1. Description: Neoprene-based, formulated for compatibility with EPDM membrane & a wide variety of substrate materials, including masonry, wood, and insulation facings.
   2. Product/Producer:
      a. RubberGard® Bonding Adhesive by Firestone.

F. Termination Bar:
   1. Description: 1.3" X 0.10" thick aluminum bar with integral caulk ledge.
   2. Product/Producer:
a. Termination Bar by Firestone.

G. Roof Walkway Pads:
   1. Description: EPDM Walkway Pads, 0.30" X 30" X 30" with EPDM tape adhesive strips laminated to the bottom.
   2. Product/Producer:
      a. QuickSeam™ Walkway Pads by Firestone.

PART 3 - INSTALLATION

3.1 EXAMINATION

A. Examine roof deck to determine that it is sufficiently rigid to support roofers and their mechanical equipment and that deflection will no strain or rupture roof components or deform deck.

B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.

C. Examine roof substrate to verify that it is properly sloped to drains.

D. Start work with sealants and adhesives at 60° - 80° F.

E. Fumes from adhesive solvents may be drawn into the building during installation through rooftop intakes. Appropriate measures must be taken to assure that fumes from adhesive solvents are not drawn into the building through air intakes.

F. For reroofing applications only: remove existing roof system components as specified.

G. The surface must be clean, dry, smooth, free of sharp edges, fins, loose or foreign materials, oil, grease and other materials that may damage the membrane. All roughened surfaces, which could cause damage, shall be properly repaired before proceeding.

H. All surface voids of the immediate substrate greater than 1/4" wide must be properly filled with an acceptable insulation or suitable fill material.

3.2 PROTECTION OF OTHER WORK

A. Protect metal, glass, plastic, and painted surfaces from adhesives and sealants.

B. Protect neighboring work, property, cars, and persons from spills and overspray from adhesives, sealants and coatings and from damage related to roofing work.

C. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trade.

3.3 MATERIAL STORAGE AND HANDLING

A. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.
B. Consult container labels and material Safety Data Sheets (MSDS) for specific safety instructions.

C. Deliver materials to job site in their original containers as labeled by the manufacturer.

3.4 ROOF INSULATION APPLICATION: GENERAL

A. Install only as much insulation as can be covered with the completed roofing system before the end of the day's work or before the onset of inclement weather.

B. Seal deck joints, where needed, to prevent bitumen drippage.

C. Lay roof insulation in courses parallel to roof edges.

D. Neatly fit insulation to all penetrations, projections, and nailers. Insulation shall be fit tightly, with gaps not greater than 1/4". All gaps greater than 1/4" shall be filled with acceptable insulation. Under no circumstances shall the roofing membrane be left unsupported over a space greater than 1/4". Tapered insulation shall be installed around roof drains so as to provide proper slope for drainage. Miter roof insulation edges at ridge, valley and other similar non-planar conditions.

E. When installing multiple layers of insulation, all joints between layers shall be staggered at least 6 in.

3.5 MEMBRANE PLACEMENT AND ATTACHMENT

A. Beginning at the low point of the roof, place the Firestone RubberGard membrane without stretching over the acceptable substrate and allow to relax a minimum of 30 minutes before attachment or splicing.

B. After making sure the sheet is placed in its final position, fold it back evenly onto itself so as to expose the underside.

C. Sweep the mating surface of the membrane with a stiff broom to remove excess dusting agent (if any) or other contaminants from the mating surface.

D. Apply Bonding Adhesive at about the same time to both the exposed underside of the sheet and the substrate to which it will be adhered so as to allow approximately the same drying time. Apply Bonding Adhesive so to provide an even and uniform film thickness. Do not apply bonding adhesive to areas that will be subsequently spliced.

E. Allow Bonding Adhesive to flash off until tacky. Touch the Bonding Adhesive surface with a clean, dry finger to be certain that the adhesive does not stick or string. As you are touching the adhesive, pushing straight down to check for stringing, also push forward on the adhesive at an angle to ensure that the adhesive is ready throughout its thickness. If either motion exposes wet or stringy adhesive when the finger is lifted, then it is not ready for mating.

F. Starting at the fold, roll the previously coated portion of the sheet into the coated substrate slowly and evenly so as to minimize wrinkles.

G. Compress the bonded half of the sheet to the substrate with a stiff push broom.

H. Fold the unadhered half of the membrane sheet back onto itself, and repeat the bonding procedure to complete the bonding of the sheet.
3.6 MEMBRANE LAP SPLICING

A. General:

1. Position the sheet at the splice area by overlapping membrane 5 inches. Once the membrane is in place, mark the bottom sheet 1/2” to 3/4” from the edge of the top sheet every 4 to 6 feet. Tack the sheet back with Firestone QuickPrime at 5’ centers and at factory splices or as necessary to hold back the membrane at the splicing area.

2. Remove excess amounts of dusting agent on the sheet and at factory splices using a stiff push broom. Stir Firestone QuickPrime thoroughly before and during use. Dip the QuickScrubber into the bucket of QuickPrime, keeping the QuickScrubber flat. Apply the QuickPrime using long back and forth type strokes with pressure along the length of the splicing area until surfaces become a dark gray in color. Apply QuickPrime to both surfaces at the same time to allow the same flash off time. Change the scrub pad each 200 feet of 3 inch field splice, or when the pad will no longer hold the proper amount of QuickPrime. Additional scrubbing is required at areas that may have become contaminated or have excess amounts of dusting agent, and at all factory splices.

3. Position the QuickSeam Splice Tape on the bottom sheet, aligning the edge of the release paper with the markings. Immediately roll the splice tape with a 3”-4” wide silicone or silicone sleeved steel hand roller or a short nap 3” paint roller.

4. When the QuickSeam Splice Tape has been installed for the entire splice length allow the top sheet to rest on top of the tape’s paper backing. Trim the top sheet as necessary to assure that 1/8”-1/2” of the QuickSeam Splice Tape will be exposed on the finished splice.

5. To remove the paper backing from the tape, first roll back the RubberGard membrane sheet, then peel the paper backing off the QuickSeam Splice Tape by pulling against the weight of the bottom sheet at approximately a 45 degree angle to the tape and parallel with the roof surface. Allow the top sheet to fall freely onto the exposed QuickSeam Splice Tape. Broom the entire length of the splice as the release paper is being removed.

6. Roll the splice using a 1-1/2”-2” wide silicone or silicone sleeved steel hand roller, first across the splice, and then along the entire length of the splice.

3.7 MEMBRANE SECUREMENT

A. Secure membrane at all locations where the membrane terminates or goes through an angle change greater than 2” in 12” except for round pipe penetrations less than 18” in diameter and square penetrations less than 4” square.

B. Mechanically fasten Reinforced Perimeter Fastening Strips per Firestone recommendations.

3.8 FLASHING - PENETRATIONS

A. General:

1. If project is a Tear-off or Reroof, remove all existing flashings (i.e. lead, asphalt, mastic, etc.).

2. Flash all penetrations passing through the membrane.

3. The flashing seal must be made directly to the penetration.

B. Pipes, Round Supports, etc

1. Flash with Firestone Pre-Molded EPDM Pipe Flashings where practical.

2. Flash using FormFlash when Pre-Molded EPDM Pipe Flashing is not practical.
C. Structural Steel Tubing:

1. Use a field fabricated pipe flashing detail provided that the minimum corner radius is greater than 1/4" and the longest side of the tube does not exceed 12". When the tube exceeds 12" use a standard curb detail.
D. Roof Drains:

1. If project is a Tear-off or Reroof remove all existing flashings, drain leads, roofing materials and cement from the existing drain in preparation for membrane and Water Block Seal.
2. Provide a clean even finish on the mating surfaces between the clamping ring and the drain bowl.
3. Taper insulation around the drain to provide a smooth transition from the roof surface to the drain. Use pre-manufactured tapered insulation with facer or suitable bonding surface to achieve slope. Slope shall not exceed Firestone recommendations.
4. Position the RubberGard membrane, then cut a hole for the roof drain to allow 1/2" - 3/4" of membrane extending inside the clamping ring past the drain bolts.
5. Make round holes in the RubberGard membrane to align with clamping bolts. Do not cut the membrane back to the bolt holes.
6. Place Water Block Seal on top of drain bowl where the clamping ring seats below the membrane.
7. Install the roof drain clamping ring and clamping bolts. Tighten the clamping bolts to achieve constant compression.

E. Pipe Clusters and Unusual Shaped Penetrations:

1. Fabricate penetration pockets to allow a minimum clearance of 1" between the penetration and all sides.
2. Secure penetration pockets per Firestone Details.
3. Fill penetration pockets with Pourable Sealer, so as to shed water. Pourable Sealer shall be a minimum of 2" deep.

F. Flexible Penetrations:

1. Provide a weathertight gooseneck set in Water Block Seal and secured to the deck.
2. Flash in accordance with Firestone Details.

3.9 FLASHING - WALLS, PARAPETS, MECHANICAL EQUIPMENT CURBS, SKYLIGHTS, ETC.

A. General:

1. Using the longest pieces practical, flash all walls, parapets, curbs, etc., a minimum of 8" high per Firestone Details.

B. Evaluate Substrate:

1. Evaluate the substrate and overlay per Firestone specifications as necessary.

C. For Tear-off or Reroof projects:

1. Remove loose or unsecured flashings.
2. Remove mineral surfaced or coated flashings.
3. Remove excessive asphalt to provide a smooth, sound surface for new flashings.

D. Complete the splice between flashing and the main roof sheet with Splice Adhesive before adhering flashing to the vertical surface. Provide lap splices in accordance with Firestone Details.
E. Apply Bonding Adhesive at about the same time to both the flashing and the surface to which it is being bonded so as to allow approximately the same flash off time. Apply Bonding Adhesive in a uniform coating.

F. Allow Bonding Adhesive to flash off until tacky. Touch the Bonding Adhesive surface with a clean, dry finger to be certain that the adhesive does not stick or string. While touching the adhesive, pushing straight down to check for stringing, also push forward on the adhesive at an angle to ensure that the adhesive is ready throughout its thickness. If either motion exposes wet or stringy adhesive when the finger is lifted, then it is not ready for mating. Flash off time will vary depending on ambient air conditions.

G. Roll the flashing into the adhesive evenly and carefully so as to minimize wrinkles.

H. Ensure proper contact of flashing by brooming in place.

I. Provide termination directly to the vertical substrate as shown on roof drawings.

J. Install T-Joint covers at field and flashing splice intersections as required by Firestone.

K. Install intermediate flashing attachment as required by Firestone Specifications and Details.

3.10 TEMPORARY CLOSURE

A. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.

3.11 ROOF WALKWAYS

A. Install walkways at all access points to the roof and around all rooftop equipment that may require maintenance and as shown on roof drawings.

B. Layout Firestone RubberGard Walkway Pads so that the flat surface is over the completed RubberGard membrane, spacing each pad a minimum of 1" and a maximum of 3" from each other to allow for drainage. Walkway pads may not be used within 10' of any roof edge or perimeter. These areas will require the installation of concrete pavers.

C. If the installation of Firestone RubberGard Walkway Pads over field fabricated splices or within 6" of a splice edge cannot be avoided, flash in the splice using QuickSeam Flashing prior to installing the walkway pad. The QuickSeam Flashing shall extend beyond the walkway pad a minimum of 6" on either side.

D. Remove the release paper. Turn the walkpad over and place it in the QuickPrime.

E. Walk on the pad to press in place assuring proper adhesion.

F. If loose laid pavers are used for walkways. Adhere a layer of RubberGard membrane beneath them to isolate them from the roofing membrane. Protection layers must extend a minimum of 2" beyond the paving stone.

3.12 SHEET METAL WORK

A. Install Firestone sheet metal as required by the manufacture.
B. Follow current industry guidelines for installation or Firestone requirements, whichever is more stringent.

3.13 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed as required by the manufacturer.

B. Correct identified defects or irregularities.

3.14 CLEAN-UP

A. Clean all contaminants from building and surrounding areas.

B. Remove trash, debris, equipment from project site and surrounding areas.

C. Repair or replace damaged building components or surrounding areas to the satisfaction of the building owner.

END OF SECTION
SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manufactured reglets with counterflashing.
   2. Formed low-slope roof sheet metal fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
   1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.4 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
C. Recycled Content of Steel-Sheet Flashing and Trim: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
   1. Surface: Manufacturer's standard clear acrylic coating on both sides.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 MANUFACTURED REGLETS

A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
   1. Material: Galvanized steel, 0.022 inch thick.
   2. Finish: Mill.
2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Obtain field measurements for accurate fit before shop fabrication.
2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

B. Counterflashing and Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

C. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective
coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.2 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with [elastomeric] [butyl] sealant and clamp flashing to pipes that penetrate roof.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer’s written installation instructions.

END OF SECTION 076200
SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Escutcheons.
4. HVAC demolition.
5. Equipment installation requirements common to equipment sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

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.”
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified. Roof top units (RTU) shall be by Carrier, York, or Trane only.
2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 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. Solder Filler Metals: ASTM B 32, 95/5 lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for 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 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. Victaulic Co. of America.
2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:
   a. 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.

2.6 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.7 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

D. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS
A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
E. 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.
F. 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.
G. Provide swing joints and expansion bends wherever required to allow the piping to expand without undue stress to connections or equipment.
H. Exposed piping around fixtures or in other conspicuous places shall not show tool marks at fittings.
I. Isolate pipe from the building construction to prevent transmission of vibration to the structure and to eliminate noise.
J. Install piping such that any equipment connected to piping may be removed by disconnecting two (2) flanges or unions and removing only one or two pipe sections. All equipment shall have bolted or screwed flanges or unions at pipe connections.
K. 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.

L. Do not route piping through transformer vaults or above transformers, panel boards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

M. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

N. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

O. Install piping to permit valve servicing.

P. Install piping at indicated slopes.

Q. Install piping free of sags and bends.

R. Install piping to allow application of insulation.

S. Eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur due to a reduction in pipe size.

T. Cap and plug all openings in pipes during construction with suitable metal plugs or cap to keep out dirt and rubbish until equipment is connected.

U. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

V. Select system components with pressure rating equal to or greater than system operating pressure.

W. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
   a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
   b. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
   c. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
   d. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
   e. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:
   a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.

e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.

f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.

g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

X. All pipes extending through the roof shall be flashed with six pound lead flashing extending 6 inches beyond the pipe, welded to a lead sleeve extended up around the vent pipes, and rolled over into the pipe.

Y. 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 below grade perimeter walls or slabs on grade shall have the space between the pipe and sleeve sealed watertight.

5. 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.

6. 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.

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.

Z. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

AA. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten
bolts against pressure plates that cause sealing elements to expand and make watertight seal.

BB. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 07 Section “Penetration Fire stopping” for materials.

CC. Verify final equipment locations for roughing-in.

DD. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA’s “Copper Tube Handbook,” using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS’s “Brazing Handbook,” ”Pipe and Tube” Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 “Quality Assurance” Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

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

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

B. Field Welding: Comply with AWS D1.1.

END OF SECTION 230500
SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes testing, adjusting and balancing HVAC systems to provide design conditions as indicated by the associated drawings. This Section includes, but is not limited to the following:

1. Test and Balance requirements for this project include:
   a. PREPROJECT maximum air flow capabilities of each unit for supply, return and outdoor air under normal operating conditions with boxes driven open to establish a system maximum base line. Readings shall be taken during UNOCCUPIED hours.
   b. MIDPROJECT air flow of each unit when brought on line (in four different phases).
   c. FINAL PROJECT balance following the procedure below and establishing the operating discharge pressure and supply/return offset for building pressurization.

2. Testing, adjusting and balancing of air and hydronic system fluid flow rates at the system and distribution system level to the indicated quantities according to tolerances specified herein. The following systems to be included:
   a. Air Systems:
      1) Constant-volume air systems.
      2) Variable-air-volume systems.

4. Verification that automatic control devices are functioning properly.
5. Measurement of sound levels as related to rotating mechanical equipment.
6. Vibration testing and analysis of all rotating equipment greater than or equal to 10 hp.
8. Reporting results of the activities and procedures specified in this Section.

1.3 DEFINITIONS


B. Adjust: To regulate fluid flow rates and air patterns at the system or terminal level. At the system level an example would be reducing fan speed; at the terminal level an example would be changing a damper position.
C. Balance: To proportion air or water flows within the distribution system, including submains, branches and terminals with respect to design quantities.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. Independent: Not affiliated with or in employment of any Contractor.


G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. TABB: Testing, Adjusting, and Balancing Bureau.

O. TAB Specialist: An entity engaged to perform TAB Work.

P. Testing, Adjusting and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.

Q. Terminal: A point where the controlled medium (fluid or energy) enters or leaves the distribution system.

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS


B. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed and prior to commencing work, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

C. Certified TAB reports.
D. Sample report forms, other than those standard forms from AABC, NEBB or TABB.

E. List of instruments and associated calibration reports to be used on project; at a minimum, this shall include the following information:

1. Instrument type and make (manufacturer and model number).
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. Agent shall be an independent testing, adjusting and balancing professional services provider certified by AABC or NEBB and have a minimum of five years experience on projects of similar scope and complexity (unless waived by WSU FP&M). Approved TAB Agent shall be considered from the following:

1. Absolut Balancing Company – South Lyon, MI.
2. Aerodynamics Inspecting Company – Dearborn, MI.
3. Air Flow Testing, Inc. – Lincoln Park, MI.
4. Enviro-Aire/Total Balance, Inc. – St. Clair Shores, MI.
5. Hi-Tech Test and Balance – Freeland, MI.
6. International Test and Balance – Southfield, MI.
7. Mechanical Testing Services, Inc. – Grandville, MI.
8. Quality Air Service – Kalamazoo, MI.

B. TAB Conference: Meet with Commissioning Authority on approval of the TAB strategies and procedures plan. This will be carried out to develop a mutual understanding of the requirements for system configuration and scheduling. Require the participation of the TAB field supervisor, TAB technicians mechanical contractor, electrical contractor and controls contractor. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:
   b. The TAB plan.
   c. Coordination and cooperation of trades and subcontractors.
   d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Commissioning Authority.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 – “Air Balancing.”

1.7 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

A. Provide seven days’ advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

C. Systems shall be fully operational prior to system balancing. If a commissioning program is in place, all startup, testing and verification (STV) procedures shall be complete prior to initiation of TAB activities.

D. Test, adjust, and balance the air systems before hydronic systems.

E. Construction Review: Provide onsite visit upon either completion of a commissioning program start-up phase or 100% controls completion and full system operability. Submit a “Systems Ready To TAB” checklist to CxA for completion by the appropriate installing contractors.

F. The mechanical contractor shall complete the installation and start all HVAC systems to ensure they are working properly, and shall perform all other items to assist the TAB contractor in performing the testing, adjusting, and balancing of the HVAC systems. Completion of a Systems Ready To TAB” checklist is required by the appropriate installing contractor prior to the beginning of TAB.

G. The mechanical contractor shall make any necessary changes to the impellers, motors, sheaves, belts, dampers as required by the TAB contractor at no additional cost to the owner. Adjustable pitch sheaves shall be replaced with fixed pitch sheaves after completing system balancing. Replaced sheaves and belts shall be disposed of by mechanical contractor.

H. The temperature control contractor shall complete the installation, and operate and test all control systems to ensure they are functioning properly as designed. The temperature control contractor shall assist the TAB contractor as needed to verify the operation and calibration of all temperature control systems. Completion of a Systems Ready To TAB” checklist is required by the appropriate installing contractor prior to the beginning of TAB.

I. Demonstration of mechanical equipment shall be performed by the mechanical contractor, or by factory trained manufacturer's representative as specified.

J. Provide instruments and technicians as required to verify readings under direction of Commissioning Authority.
PART 3 - EXECUTION

3.1 TEST EQUIPMENT

A. Instrumentation shall be provided as necessary and appropriate to perform the work. The instrument shall be factory calibrated, and shall be used with the factory-determined application factors. When reasonable doubt of accuracy exists, recalibration of any or all instrumentation shall be performed as requested by the Commissioning Authority.

B. Proprietary test equipment shall be provided by the manufacturer of the equipment. The manufacturer's representative shall provide the equipment, demonstrate use of the equipment, and assist the TAB contractor or Commissioning Authority in the testing process.

C. Make instruments available to the Commissioning Authority to facilitate TAB data verification during testing.

D. Test pressure taps, pressure gages, thermometers and wells shall be installed by the mechanical contractor as indicated or specified.

E. Flow measuring stations, flow-limiting devices and balancing valves shall be installed by the mechanical contractor as indicated or specified.

F. All manual volume dampers located above ceilings shall be outfitted with a ribbon of consistent color and type and installed by mechanical contractor for facilitation of locating dampers during TAB.

G. Any additional required pressure and flow taps, and thermometer wells in locations where permanent installation devices are not indicated or specified shall be provided by the mechanical contractor.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems’ designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems’ output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section “Metal Ducts” and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
F. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that mechanical contractor has replaced startup screens with permanent screens having indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping; mechanical contractor to assist as necessary.

O. Temperature controls contractor shall aid in the examination of operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures to the Commissioning Authority. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Procedure shall include a project specific approach which integrates general methods as set forth by the AABC as per National Standards for Total System Balance and/or NEBB as per Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

C. Verify completion of the “Systems Ready to TAB” report. It shall include the following items:
   1. Permanent electrical-power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, the mechanical contractor shall install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Note in report, as applicable, all final settings of variable frequency drives for specified design conditions, the associated static pressures/differential pressures observed and the conditions under which the system was tested, adjusted and balanced.

E. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity as applicable. This plan shall be discussed and agreed upon with the Commissioning Authority. The final plan for diversity shall be reflected in the report by which it pertains.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:
   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Fan speed shall not be increased in access of manufacturer’s maximum recommended RPM. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Discuss plan to simulate diversity with CxA and document agreed upon procedure prior to beginning work.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Coordinate with temperature control contractor to calibrate any airflow measuring devices installed in the air-handling systems. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
   a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Upon completion of the above scope of work, place all variable air terminal units to full cooling mode, measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit. At this time, coordinate with the temperature controls contractor to verify that all variable air terminal unit dampers, namely the critical terminal unit damper, are near but less than 100% open. Adjust system to achieve this condition therefore optimizing energy consumption and validating design airflow conditions during requirements for full load.

8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.
3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
   a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.

3. Set terminal units at full-airflow condition.

4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Adjust terminal units for minimum airflow.

6. Measure static pressure at the sensor.

7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump at maximum RPM with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

   a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Division 23 Section "Hydronic Pumps."
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer’s head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
   a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer’s performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated settings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems’ pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems. Once TAB is complete per the specified procedures above, note the final differential pressure output which indicates the design flow condition. Fully open the metering valve located at the pump discharge. Decrease speed at variable frequency drive until differential pressure matches that originally attained at design conditions.
3.11 PROCEDURES FOR STEAM SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.

B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.

C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

D. Check settings and operation of each safety valve. Record settings.

E. Verify the operation of each steam trap.

3.12 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check settings and operation of safety and relief valves. Record settings.

3.13 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.14 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.
3.15 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.16 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the condition of dampers.
7. Verify appropriate location of balancing devices such that accurate measurements can be attained and final TAB can be completed.
8. Check the operation of the drain pan and condensate-drain trap.
9. Check bearings and other lubricated parts for proper lubrication.
B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Dampers functioning properly.
6. Verify correct operation of existing measurement/balancing devices (e.g., dampers, gauges, valves, etc.)
7. Bearings and other parts are properly lubricated.
8. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.17 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Adjust pumps to within 10% of design GPM at design temperature. Excess pump pressure shall be eliminated by trimming the pump impeller by the Mechanical Contractor (this shall be carried out by the mechanical contractor).

C. General rotating equipment maximum allowable self-excited, total unfiltered vibration velocity shall not exceed 0.15 inches per second peak to peak. Individual velocity amplitude peaks of filtered readings are not to exceed 0.10 inches per second peak to peak.

D. Direct drive pump maximum allowable self-excited, total unfiltered vibration velocity shall not exceed 0.10 inches per second peak to peak. Individual velocity amplitude peaks of filtered readings are not to exceed 0.05 inches per second peak to peak.

3.18 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to
facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices. Also, include system schematic diagrams consistently referenced with all equipment and test points, and preliminary test data.

B. Status Reports: Prepare [weekly] monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.19 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Upon verification and approval of draft reports, submit 1 complete set of final reports certified by the TAB contractor for the Architect and 2 sets for inclusion in operating and maintenance manuals. Bind report forms complete with schematic diagrams and data in reinforced, vinyl, 3-ring binder manuals.
   2. As-built system schematic diagrams consistently referenced with all equipment and test points, and final test data.
   3. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   4. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
   2. Name and address of the TAB contractor.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   9. Signature of TAB supervisor who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents including the following:

   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
   a. Settings for outdoor-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Face and bypass damper settings at coils.
   e. Fan drive settings including settings and percentage of maximum pitch diameter.
   f. Inlet vane settings for variable-air-volume systems.
   g. Settings for supply-air, static-pressure controller.
   h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches (mm), and bore.
   i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
   j. Number, make, and size of belts.
   k. Number, type, and size of filters.
2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches (mm), and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):
   a. Total air flow rate in cfm (L/s).
   b. Total system static pressure in inches wg (Pa).
   c. Fan rpm.
   d. Discharge static pressure in inches wg (Pa).
   e. Filter static-pressure differential in inches wg (Pa).
   f. Preheat-coil static-pressure differential in inches wg (Pa).
   g. Cooling-coil static-pressure differential in inches wg (Pa).
   h. Heating-coil static-pressure differential in inches wg (Pa).
   i. Outdoor airflow in cfm (L/s); this should be tested in both maximum and minimum conditions.
   j. Return airflow in cfm (L/s); this should be tested in both maximum and minimum outdoor air conditions.
   k. Relief airflow in cfm (L/s); this should be tested in both maximum and minimum outdoor air conditions.
   l. Outdoor-air damper position.
   m. Return-air damper position.
   n. VFD frequency setting (Hz) and final static pressure set point; clearly indicate system configuration during testing.
   o. Calibration of airflow stations (any that exist on the air-handling unit).

F. Apparatus-Coil Test Reports:

1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch (mm) o.c.
   f. Make and model number.
   g. Face area in sq. ft. (sq. m).
   h. Tube size in NPS (DN).
   i. Tube and fin materials.
   j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm (L/s).
   b. Average face velocity in fpm (m/s).
   c. Air pressure drop in inches wg (Pa).
   d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
   e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
h. Water flow rate in gpm (L/s).
i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).
n. Refrigerant suction temperature in deg F (deg C).
o. Inlet steam pressure in psig (kPa).

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches (mm), and bore.
   h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches (mm), and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
   g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm (L/s).
   b. Total system static pressure in inches wg (Pa).
   c. Fan rpm.
   d. Discharge static pressure in inches wg (Pa).
   e. Suction static pressure in inches wg (Pa).
   f. VFD frequency setting (Hz) and associated 2/3 static pressure reading in inches wg corresponding to design airflow.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
   a. System and air-handling-unit number.
   b. Location and zone.
   c. Traverse air temperature in deg F (deg C).
   d. Duct static pressure in inches wg (Pa).
Wayne State University
FAB Rooftop Air Conditioning Unit Replacement
1/28/15
WSU Job #130-252650

DSD PROJECT No. 14-4802.00 TESTING, ADJUSTING AND BALANCING FOR HVAC 230593 - 20

I. Air-Terminal-Device Reports:

1. Unit Data:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Apparatus used for test.
   d. Area served.
   e. Make.
   f. Number from system diagram.
   g. Type and model number.
   h. Size.
   i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm (L/s).
   b. Air velocity in fpm (m/s).
   c. Preliminary air flow rate as needed in cfm (L/s).
   d. Preliminary velocity as needed in fpm (m/s).
   e. Final air flow rate in cfm (L/s).
   f. Final velocity in fpm (m/s).
   g. Space temperature in deg F (deg C).
   h. Indicate final flow coefficient.
   i. Percent of design achieved.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
   a. System and air-handling-unit identification.
   b. Location and zone.
   c. Room or riser served.
   d. Coil make and size.
   e. Flowmeter type.

2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm (L/s).
   b. Entering-water temperature in deg F (deg C).
   c. Leaving-water temperature in deg F (deg C).
   d. Water pressure drop in feet of head or psig (kPa).
   e. Entering-air temperature in deg F (deg C).
   f. Leaving-air temperature in deg F (deg C).
   g. Terminal flow measuring device (circuit setter, flow meter, etc.) make/model/size.
h. Terminal flow measuring device water pressure drop (as required to determine terminal unit flow).
i. Final setting of flow measuring device valve handle indicator.
j. Percent of design achieved.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
   e. Model number and serial number.
   f. Water flow rate in gpm (L/s).
   g. Water pressure differential in feet of head or psig (kPa).
   h. Required net positive suction head in feet of head or psig (kPa).
   i. Pump rpm.
   j. Impeller diameter in inches (mm).
   k. Motor make and frame size.
   l. Motor horsepower and rpm.
   m. Voltage at each connection.
   n. Amperage for each phase.
   o. Full-load amperage and service factor.
   p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig (kPa).
   b. Pump shutoff pressure in feet of head or psig (kPa).
   c. Actual impeller size in inches (mm).
   d. Full-open flow rate in gpm (L/s).
   e. Full-open pressure in feet of head or psig (kPa).
   f. Final discharge pressure in feet of head or psig (kPa).
   g. Final suction pressure in feet of head or psig (kPa).
   h. Final total pressure in feet of head or psig (kPa).
   i. Final water flow rate in gpm (L/s).
   j. Voltage at each connection.
   k. Amperage for each phase.
   l. Final design flow rate using discharge metering valve (ie triple duty valve, multi-purpose valve) at maximum VFD frequency (Hz); indicate differential pressure in feet of head at design conditions.
   m. Final VFD frequency setting (Hz) and associated 2/3 differential pressure (psig) measurement/set point required to achieve design conditions; clearly indicate system configuration during testing.
   n. Calibration of hydronic flow station(s).

L. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
d. Dates of use.
e. Dates of calibration.

3.20 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
   2. Check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure water flow of at least 5 percent of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
      d. Verify that balancing devices are marked with final balance position.
      e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:
   1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
   2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
   3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
   4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
   5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
   1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
   2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.21 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593
SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

   a. Calcium silicate.
   b. Cellular glass.
   c. Flexible elastomeric.
   d. Mineral fiber.
   e. Phenolic.
   f. Polyolefin.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
7. Sealants.
8. Factory-applied jackets.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.
1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

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

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation.
1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate:

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

   a. Industrial Insulation Group (The); Thermo-12 Gold.
2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Pittsburgh Corning Corporation; Foamglas Super K.
   2. Block Insulation: ASTM C 552, Type I.
   3. Special-Shaped Insulation: ASTM C 552, Type III.
   4. Board Insulation: ASTM C 552, Type IV.
   5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
   7. Factory fabricated shapes according to ASTM C 450 and ASTM C 585.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Duct Wrap.
      d. Owens Corning; All-Service Duct Wrap.

I. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Micro-Lok.
      b. Knauf Insulation; 1000 Pipe Insulation.
      c. Owens Corning; Fiberglas Pipe Insulation.

J. Phenolic:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Kingspan Corp.; Koolphen K.
2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricated shapes according to ASTM C 450 and ASTM C 585.

2.2 INSULATING CEMENTS

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).
C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
D. 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.; Aeroseal.
      b. Armacell LCC; 520 Adhesive.
E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
G. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Chemical Company (The); 739, Dow Silicone.
2.4 MASTICS

2.5 LAGGING ADHESIVES

2.6 SEALANTS
   A. Joint Sealants:
      1. Materials shall be compatible with insulation materials, jackets, and substrates.
      2. Permanently flexible, elastomeric sealant.
      3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
   B. FSK and Metal Jacket Flashing Sealants:
      1. Materials shall be compatible with insulation materials, jackets, and substrates.
      2. Fire- and water-resistant, flexible, elastomeric sealant.
      3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
   C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
      1. Materials shall be compatible with insulation materials, jackets, and substrates.
      2. Fire- and water-resistant, flexible, elastomeric sealant.
      3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

2.7 FIELD-APPLIED JACKETS
   A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
   B. Metal Jacket:
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. Childers Products, Division of ITW; Metal Jacketing Systems.
         a. Factory cut and rolled to size.
         b. Finish and thickness are indicated in field-applied jacket schedules.
         d. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches (75 mm).
   2. Thickness: 11.5 mils (0.29 mm).
   3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches (75 mm).
   2. Thickness: 6.5 mils (0.16 mm).
   3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
   1. Width: 2 inches (50 mm).
   2. Thickness: 6 mils (0.15 mm).
   3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches (50 mm).
SECTION 230923 – DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes a complete and functional direct digital Energy Management Control System (EMCS) as specified herein. The basis of design is the Siemens Building Technologies, Inc. Control System. Siemens shall have total system responsibility for the installation including the following:

1. Furnish and install all software, hardware, data base, conduit, wire, cable, building level controller units, floor level controller units and required connections for a complete and functional system to monitor and control points as specified, including software and data base generation, loading, debugging, and start-up.

2. Generation of color graphic displays at the existing graphic terminal for each mechanical system connected to the system. Graphics to include all dynamic point data information associated with each major mechanical system and set points.

3. Provide complete hardware and software documents, shop drawings, operating and maintenance manuals and classroom training of operators and maintenance personnel at the site. Provide as-built control drawings in CAD format to Owner.

4. Provide power supply to each controller cabinet and communications interface. Provide manufacturers recommended grounding to each controller cabinet, and dedicated 120V, 20A circuit with locking clip on breaker. Clearly label circuit in panel.

5. Accomplish acceptance tests, including point-to-point verification, with enhanced alarming verification including messages for all points selected by the Owner. Typical points with messages include control air compressor, 24 hour fans and pumps, critical systems and animal areas.

6. Provide connections for all electrical devices provided by the temperature control contractor to the controllers.

7. Provide proper marking and identification of all devices, wiring, and controls.

8. Guarantee.

9. AC Units will be BACNet compatible and will require interface of controls and significant coordination by the temperature control supplier and manufacturer. See drawings for additional requirements.

1.3 DEFINITIONS

A. DDC: Direct digital control.
B. I/O: Input/output.

C. RTD: Resistance temperature detector.

1.4 SYSTEM DESCRIPTION

A. The temperature control system shall be of the DDC type, connected to the University's present Energy Monitoring and Control System.

B. All materials and equipment used shall be standard components, regularly manufactured for Siemens Building Control Systems and shall not be custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use, and shall include, but not be limited to:

1. Controller cabinets with all electronics and transducers, including communications board and RAM battery back-up. Provide latest revision firmware and largest available memory board.
2. Communications interface devices.
3. RTD.
4. Printed circuit assemblies, point modules.
5. Auxiliary device enclosures.
6. Control and status relays.
7. Current transformers.
8. Thermowells (Mechanical Contractor shall install wells furnished by the EMCS contractor)
9. Temperature and pressure transmitters.
10. Water flow sensors and transmitters.
11. Electric to pneumatic transducers.
12. Pneumatic to electric transducers, standard shall be 0 to 20 psi unless noted otherwise, include brass fittings on all pneumatic devices.
13. Power supplies to controller cabinets, transducers, and other control devices.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

B. Shop Drawings:

1. Submit complete shop drawings of the proposed TCS for approval including sequence of operation, valve ranges, DDC logical points and physical addresses, typical system information such as fan CFM, voltage, FLA, HP, GPM, etc.
2. Submit complete shop drawings of the proposed EMCS system for approval including, but not be limited to the following:

   a. I/O point summary with recommended set points, start/stop times, time delays, etc.
b. Operator and hardware point numbers, logical names and user names.

c. Controller unit schematic wiring, layout sheet including logical point names, valve ranges, etc.

d. Fan and mechanical system schematic diagrams showing EMCS sensor locations, including valve ranges, CFM, voltage, FLA, GPM and areas served.

e. One-line diagrams for sensors, control points, and terminations, including labeling to controller cabinets, with all components, signal values, and cables.

f. Terminal cabinets, including labeled terminal blocks.

g. Connections to existing loops, controls, and panels.

h. Internal and external wiring of relays and contacts.

i. Schematic of all major equipment provided.

j. Operator, maintenance, and software programming manuals.

k. Spare parts list and prices.

l. Complete sequence of operation, description, control logic flow diagrams, and completed programming sheets in manual form for each mechanical system controlled.

3. All manufacturer's drawings, catalog cuts, and specifications shall be properly identified with the Engineer's project number and title. Each piece of equipment shall be properly identified as to its location and equipment number. Verify Equipment numbering with WSU Central Control.

4. SUBMITTALS data relevant to panel schedules and other pertinent equipment information requiring approval prior to field installation shall be forwarded from the Contractor. Upon receipt of approval, the Contractor shall proceed with installation, set-up, calibration and check out of the various control and monitoring systems. At the completion of components and systems installation the Contractor shall request in writing that the Owner inspect and approve satisfactory operation as specified under "Acceptance Procedure".

C. Field quality-control test reports.

D. As-built Drawings:

1. At the completion of the project as-built drawings shall be submitted to the Owner, showing conduit size and location, cable and wire identification, panel and sensor locations, and device layouts with panels, branch circuit numbers, and wiring diagrams for each type of typical field point wiring and for each specific variation, and data trunk riser diagram.

2. Furnish 4 sets of neatly drawn as-built diagrams of the temperature control systems, complete with sequence of operations, valve ranges, cabinet layout sheets, point logical names and physical addresses. One set to be mounted in plastic covers located in control cabinets in the field, one set to be delivered directly to Central Control, two sets to be delivered to Construction Representative for Archives and records. One set of AutoCAD as-built drawings on 3 ½” high density diskettes shall be furnished to Design Representative to be delivered to Engineering Services. File naming convention shall be as determined by Owner.

E. Operations and Maintenance Manuals:
1. The system shall be provided with complete maintenance and operation instructions including, but not limited to the following:

   a. Complete electronic schematic wiring diagrams for printed circuit boards, DDC Controller cabinets and other equipment included in these Specifications.
   b. Complete instruction set in manual form for operation of the system.
   c. Complete instruction set in manual form for adding and deleting of points and interface device panels including all relevant parameters such as descriptor inputs, point types, change-of-state type, functions, etc.
   d. Complete diagnostic and trouble shooting procedures set in manual form.
   e. Complete instruction set in manual form for all software and firmware.

2. Any updates to firmware, software, and hardware shall be fully documented at or before the time of delivery.

1.6 INPUT/OUTPUT SUMMARY FORM

A. The following I/O Summary Form is a sample form illustrating the typical information required of the various building systems. Any device connected to the EMS that is also controlled by some local device (e.g.: light switch, P.E., high limit stat, twist timer, etc.) must be defined as an DI point. Provide dry contact from local device to digital input at controller and programming necessary to accomplish sequence of operation.

B. Typical control points connected to the EMCS system are as follows:

1. HVAC/H&V Systems:
   a. Supply fan (status and control).
   b. Return fan (status and control where fan is not interlocked w/supply).
   c. Mixed air temperature.
   d. Heating coil temperature.
   e. Cooling coil temperature.
   f. Discharge air temperature.
   g. Return air temperature.
   h. Return air relative humidity.
   i. Damper control.
   j. Steam valve control.
   k. Cooling coil control.
   l. Humidifier control.
   m. Space humidity sensor (where humidity control is critical).
   n. At least one space temperature sensor per system or zone.

2. Hot Water Heating Systems:
   a. Hot water heating pump (status and control).
   b. Hot water heating supply temperature (at each convertor).
   c. Hot water heating return temperature (at each convertor).
   d. Hot water heating common supply temperature.
e. Hot water heating common return temperature.
f. Steam valve control.

3. Miscellaneous Building Systems:
   a. Outdoor air temperature.
   b. Temperature control air compressor low pressure alarm.
   c. Fire (trouble circuit).
   d. Fire (fire alarm circuit).
   e. Domestic hot water temperature.
   f. Exhaust fans (status and control) including:
      1) Toilet exhaust.
      2) General exhaust.
   g. Microprocessor fault indication.
   h. Building steam shutoff valve (include adequate space temperature points to calculate the proper O.A. temperature to open and close the steam valve in order to maintain 68°F (winter) and 78°F (summer) building temperatures.
   i. Street light control and status.

1.7 QUALITY ASSURANCE
   A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
   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 ASHRAE 135 for DDC system components.

1.8 DELIVERY, STORAGE, AND HANDLING
   A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
   B. System Software: Update to latest version of software at Project completion.

1.9 COORDINATION
   A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
B. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.

C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

D. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

E. Coordinate equipment with Division 26 Section "Panel boards" to achieve compatibility with starter coils and annunciation devices.

F. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

1.10 WARRANTY

A. The EMCS system shall be guaranteed for a period of one year after final approval by the Owner. The guarantee shall be provided for a completely installed system, including all components, parts, and assemblies of the EMCS. The guarantee shall cover parts, materials, and labor to locate and correct any defects in materials or workmanship.

B. The Contractor shall initiate the warranty period by formally transmitting to the Owner commencement notification of the period for the system and devices accepted.

C. A telephone number or numbers shall be provided for quick service engineering assistance concerning hardware and software problems. There shall be provisions made for getting an expert on the scene quickly should the need arise. There shall also be a software expert familiar with the software of this machine who can be easily contacted.

D. This system shall be inspected by the manufacturer for a four hour period once each month during the warranty period to run diagnostic tests and also provide maintenance instructions to the operating personnel.

E. The Contractor shall give the Owner 24 hours prior notification of each maintenance trip during the contract guarantee period. In addition, the Contractor shall furnish the Owner and Engineer a written record of each maintenance trip, number of employees present, time involved, and work accomplished.

F. Owner shall be able to make changes to data base, when prior data base is stored on disk in case of error in change, without affecting or voiding warranty.

1.11 MAINTENANCE

A. The EMCS Contractor shall provide and maintain on site at WSU working spare parts for EMCS system during the warranty period including DDC Controllers, communication boards, modules, sensors, LAN devices, transformers, etc. WSU will be custodian of these spare parts.
and shall be authorized to utilize them in performing first level maintenance. The EMCS Contractor shall refurbish/replace spare parts in exchange for failed items.

B. Contractor shall provide a spare parts list and price list for the recommended spare parts to maintain the EMCS after the first year of operation. Submit these lists with the shop drawings.

PART 2 - PRODUCTS

2.1 CURRENT SENSORS (TRANSFORMERS)

A. Current sensors used for monitoring motor operation shall be sized according to motor horsepower. The output shall be compatible with the EMCS field device with necessary interfacing transducers provided.

B. The current sensors shall have mounting brackets for attachment to the motor starter enclosure.

C. Manufacturers: Veris model 921.

2.2 CURRENT SENSING RELAYS

A. Current sensing relays shall be used for monitoring motor operation, and sized according to motor HP.

B. Manufacturers: Veris model 908 or RIB Model RIBXGTA.

2.3 RESISTANCE TEMPERATURE DETECTORS (RTD)

A. Resistance temperature detectors shall be wire wound or thin film platinum resistance type sensors, with an accuracy of ± 0.5°F over the noted range. All sensors of a particular category shall be of the same type and manufacturer.

B. Sensors shall be two-wire type, and shall be provided with local 4-20 MA signal conditioner. The minimum temperature range for all sensors will be 20°F, to 120°F. Sensors shall have a maximum time constant of three seconds per degree change. Sensors shall not require recalibration at any time. Where required, linearizing, ranging, and resistance change versus temperature curve interpretations shall be made by software programming at the CPU or Controller. Minimum room temperature sensor range is 40-90 degree F. Wider range may be required for special applications.

C. Resistance temperature detectors shall be either stem or tip sensitive types. Sensors installed outdoors, in piping systems, and in corrosive environments shall be hermetically sealed in type 316 stainless steel enclosures, with all joints and closures Heliarc welded. Soldering or brazing is not approved. Entire assembly, including external trim, shall be a watertight, vibration proof, heat resistant unit.
D. Sensing elements installed in piping systems shall be provided with separable wells constructed of type 316 stainless steel. Elements shall be inserted into the wells with appropriate heat transfer compound.

E. Sensors installed outdoors shall be weatherproof construction, protected from sunlight and wind effects with a stainless steel protective shield.

F. All duct mounted temperature sensors shall be of the averaging type, with 17' or 25' long sensing elements. Averaging elements shall be installed across the full air flow area in a serpentine fashion, on rigid supports designed specifically for mounting of such elements. The averaging element shall be protected against vibration and wear at each point of contact with the element supports. Strain on the element shall be relieved at the junction box to prevent tension on the internal electrical connections.

G. Rigid stem averaging sensors will be allowed where duct size is smaller than 3' square.

2.4 STATIC PRESSURE TRANSMITTERS

A. Static pressure transmitters shall be industrial quality, capable of transmitting 4-20mA analog output signal proportional to differential (static) pressure input signals. Transmitter shall have 1% accuracy, zero and span adjustment, and stainless steel case.

B. Manufacturers: Setra Model C264.

2.5 ELECTRONIC TO PNEUMATIC TRANSDUCERS

A. Damper end switches shall be two position, encapsulated mercury style mounted on the shaft arm, SPDT, unless noted otherwise. Where electronic actuators are used end switches provided with actuator will be allowed.

B. Accessories: In-line filter, dual valve and gauge.

C. Manufacturers: PXP model EPC2GFS style by Advanced Control Technologies, Inc.

2.6 DAMPER END SWITCHES

A. Damper end switches shall be two position, encapsulated mercury style mounted on the shaft arm, SPDT, unless noted otherwise. Where electronic actuators are used end switches provided with actuator will be allowed.

2.7 EMCS CABLE

A. All EMCS cable shall be installed in conduit. EMCS cable shall comply with manufacturer’s recommendations. Separate raceway systems shall be supplied for Class I and Class II circuits.
B. Data transmission trunk cables and equipment grounding procedures shall meet the latest FCC guidelines (FCC rules, part 15, subpart J) for electromagnetic field generation.

C. No splicing of communication trunk shall be allowed. Communication trunk shall be installed per manufacturers recommendation for operation at 19,200 baud or higher, continuous daisy chain with no tees and trunk terminators installed where appropriate. All communication and analog input wiring shall be AWG size as recommended by manufacturer with teflon jacket.

D. Splicing of temperature sensor cable is not allowed.

E. Splicing of binary status or command cable shall take place at the field cabinet or motor starter only.

2.8 DDC CONTROLLERS

A. Controllers shall be complete assemblies consisting of modular hardware including power supply, microcomputer, input/output modules, termination modules, and battery. Battery shall be non-rechargeable lithium with 10 year life, and be capable of supporting all memory within the control unit if the house power to the unit is interrupted or lost for a minimum of 60 days total down time.

B. Controllers shall be furnished as newest revision level with largest available memory configuration unless prior approval by Owner. Verify with Owner if MEC or PXC Modular shall be used in the design. PXC compact may be used in special cases upon Owner approval. Most recent revision firmware shall be supplied unless otherwise noted. Expansion cabinets shall NOT be utilized in the design without prior approval by the Owner. All points associated with a particular mechanical system shall be connected to the same Controller. Each controller shall be provided with 10% spare point capacity. MEC’s and PXC’s shall be provided with floor level network capability and H-O-A switches at the output points.

C. All points from a given mechanical system shall reside in the same controller.

D. Each Controller cabinet shall be able to monitor the following types of inputs:

<table>
<thead>
<tr>
<th>Analog Inputs</th>
<th>Digital Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-20 mA</td>
<td>Dry contact closure</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>Pulse accumulator</td>
</tr>
<tr>
<td>1000 ohm</td>
<td></td>
</tr>
</tbody>
</table>

E. Controller cabinets shall directly control pneumatic and electronic actuators and control devices. Each control unit shall be capable of providing the following control outputs:

<table>
<thead>
<tr>
<th>Analog Outputs</th>
<th>Digital Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-18 psi</td>
<td>Motor starters, sizes 1 to 4</td>
</tr>
<tr>
<td>4-20 mA</td>
<td></td>
</tr>
<tr>
<td>0-10 VDC</td>
<td></td>
</tr>
</tbody>
</table>
F. All temperature control functions shall be executed within the same DDC Controller. Loop control shall be executed via direct digital control algorithms. The user shall be able to customize control strategies and sequences of control, and shall be able to define appropriate control loop algorithms and choose the optimum loop parameters for loop control. Upon Owner request demonstrate stable loop control by utilizing test cabinet simulation program and trending the data. Control loops shall support any of the following control modes:

1. Two position (on-off, slow-fast, etc.)
2. Proportional (P)
3. Proportional plus integral (PI)
4. Proportional, integral, plus derivative (PID)

G. It shall be possible to fully create, modify, or remove control algorithms within a specific DDC Controller while it is operating and performing other control functions. Input for these changes may be made directly into the DDC Controller or via the network from any other control unit. Each control loop shall be fully user definable in terms of:

1. Sensors/actuators that are part of the control strategy.
2. Control mode.
4. Control action.
5. Sampling time.

H. DDC Controller shall be able to share point information such that control sequences or control loops executed at one control unit may receive input signals from sensors connected to other DDC Controllers within the network. If the network communication link fails or the other DDC Controller malfunctions, the control loop shall continue to function using the last value received from the Controller.

I. The system shall permit the generation of job-specific control strategies that can be activated in any of the following ways:

1. Continuously.
2. At a particular time of day.
3. On a pre defined date.
4. When a specific measured or controlled variable reads a selected value or state.
5. When a piece of equipment has run for a certain period of time.

J. Upon a loss of commercial power to any DDC Controller, the other units within the network shall not be affected and the loss of operation of that unit shall be reported at the designated operator's terminal. All control strategies and energy management routines defined for the DDC Controller shall be retained during power failure via the internal battery for a minimum of eight (8) hours. Upon resumption of commercial power the control unit shall resume full operation without operator intervention. The unit shall also automatically reset its clock such that proper operation of timed sequences is possible without the need for manual reset of the clock.

K. Location of DDC Controller cabinets shall be approved by the Owner prior to installation.
L. Enclose and install control devices and equipment such that they will not be subject to vibration, excessive temperature, dirt, moisture, or other harmful effects or conditions beyond their rated limitations. If devices must be located so as to be subjected to conditions beyond their recommended or rated limitations, provide the necessary protective enclosures or furnish the equipment constructed of materials and features capable of withstanding the adverse conditions. Controls and devices subject to wetting or to the weather shall be corrosion resistant weather tight enclosures.

M. PPCL programs shall follow MSU standard form and shall include discrete sections of code that are not intermingled with other sections of control, per the following:

   1. Increment line numbers by 10 or more. First line number shall be greater than or equal to 10, last line number shall be less than or equal to 32000.
   2. Place all time-based commands (e.g. WAIT, TOD, SAMPLE, LOOP) such that they are evaluated each pass through the program.
   3. Include comments describing each section of code.
   4. Section A shall include all diagnostic, power return, emergency point and other related code.
   5. Section B shall include all equipment schedules.
   6. Section C shall include all DDC and other equipment control.
   7. Section D shall include all LFSSL sequencing, alarm delays, alarm limits and miscellaneous code and odd month determination.
   8. Each PCL file shall include the alarm indicators code in Section A. Each PCL file shall include code in Section E that initialize the run time totals on all equipment defined for totalization. Each PCL file shall include an emergency point that passes control from the end of Section A to the beginning of Section C, whenever the emergency point is on.
   9. Any air handling unit with a heating coil controlled through DDC shall include failed AI programming. A complete printout of the following for each building database shall be provided: MASPNT, SYN, EQU, PROCED, CLOCK, TOD and PCL.
   10. Each controller cabinet shall include only one program. Multiple programs in a cabinet must be approved by WSU Central Control. Each program shall be tested utilizing a test cabinet simulation to verify program functions properly, prior to loading in field cabinet.

N. Hot Water Heating Systems designed with 100% backup shall alternate pump/boiler operation based on Odd/Even month per WSU standard programming. If a pump fails to operate, the backup pump shall be commanded on and sent an emergency notification to appropriate printer.

O. Point database entry shall follow these conventions:

   1. Descriptors:  AI: use range of device, e.g. 20-120; AO: use range of device and normal position of device, e.g. NC 3-15 (normally closed 3 to 15 PSI); DO: use valid commands, e.g. ON OFF; DI use word STATUS.
   2. Alarmability: All alarmable points shall be displayed at each console screen and the event printer.
   4. Change of Value Limit: No less than 2% and no greater than 10% of range of device.
   5. Engineering Units: DEG F, AMPS, PPM, IN WC, PCT RH, PSI, CFM, GPM, etc.
6. Command String and State Descriptors: These two shall typically match each other. Some common entries are ON/OFF, ENABLE/OFF, OPEN/CLOSE, FAST/OFF/SLOW, ON/OFF/AUTO.

7. Motor Status Summary: All points that represent the ON/OFF status of equipment shall be included in this summary.

8. Totalization: All points that indicate the run-time of a piece of equipment shall be included in this summary with time totalized per hour.

9. Contact State Descriptor: Fire alarm and fire trouble points: use a period for both states. Control air compressor: use a period for the normal state and LOW for the off-normal state. Avoid using the words NORMAL and ALARM as state descriptors for alarmable points. Return to Normal Printouts: Yes, in all instances.

10. Naming convention shall follow WSU Standard and approved through Central Control.

11. All high priority equipment shall have 24 hour alarming with messages entered, such as 24 hour lab exhaust fans, 24 hour lab supply fans, hot water heating pumps, animal room equipment, etc.

2.9 APPLICATION SPECIFIC CONTROLLERS

A. Each DDC controller shall be able to extend its performance and capacity through the Use of LAN, floor level, application specific controllers (ASCs).

B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.

C. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences.

D. Each controller performing space temperature control shall be provided with a matching room temperature sensor. Each room temperature sensor shall be provided with a terminal jack to be used to connect a portable operator’s terminal to control and monitor TEC points, setpoint adjustment dial, temperature indicator, and override switch.

E. A dedicated power source and separate isolation transformer for each LAN power Trunk shall be provided. Transformer shall be mounted in a separate auxiliary enclosure.

2.10 ELECTRONIC ACTUATORS

A. Upon approval from Owner, electronic actuators may be allowed for terminal equipment.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install engraved laminated plastic nameplates under each instrument in the control panel to designate its function.

B. All devices connecting to EMCS such as contactors, motor starters, electric pneumatic transducers, pressure electric transducers, resistance temperature detectors, relays, etc., shall be marked with the same point number used on the shop drawing SUBMITTALS for the system so as to identify the point and its function. Marking shall be done with gummed paper tags installed on the surfaces that have been steel wool cleaned and sprayed with clear enamel for waterproofing.

C. Wire shall be color coded according to the Construction Representative's directions.

D. Dedicated circuits shall be installed in branch lighting panels to serve controller cabinets. Circuit breakers shall be equipped with locking clips, and shall be clearly identified.

E. All Controller Cabinets and auxiliary enclosures shall be supplied with engraved phenolic nameplates permanently attached identifying their field cabinet number, area, fan systems controlled, etc.

F. Special equipment shall be installed in accordance with manufacturer's instructions and recommendations of Service Engineer where specified or required. All control instruments, valves, etc., shall be carefully adjusted and set for proper operating of the equipment served as noted herein or as required by the equipment manufacturer's instructions and recommendations.

3.2 FIELD QUALITY CONTROL

A. Upon completion of the work, the Contractor shall instruct the Owner's Operating Engineer and acquaint him with all of the operating characteristics of all equipment installed by him including the TCS and all other systems, at the same time operating each and every system individually for a period of two days, unless otherwise specified. During this two day period the building's Operations Manual shall be used for reference.

B. During system commissioning and at such time acceptable performance of the installed system hardware and software has been established, the Contractor shall provide on-site operator instruction to the Owner's operating personnel. Operator instruction during normal working hours will be performed by competent contractor representatives familiar with the computer's software, hardware, and accessories.

C. At a time mutually agreed upon during system commissioning as stated above, the Contractor shall give an absolute minimum 24 hours of instruction to the Owner's designated personnel on the operation of all equipment included in the project. Operator orientation of the automation system will include, but not be limited to equipment functions, commands, advisories, appropriate operator intervention required in responding to the system's operation, and any other
training needed in the operation of the system. An Owner's manual prepared for this project by the Contractor will be used in addition to the instruction. Six (6) manuals shall be provided.

D. Additional instruction time as deemed necessary by the Owner shall be provided by the Contractor as an extra service, and will be paid for in accordance with the State Prevailing Wage Rates for Engineers and Technicians.

3.3 ACCEPTANCE PROCEDURE

A. SUBMITTALS data relevant to point index, functions limits, sequences, interlocks, power fail/restarts, logs, software routines and associated parameters, and other pertinent information for the operating system and data base shall be forwarded from the EMCS contractor to the Owner.

B. Approved data base will be entered into the central computer, debugged, and down line loaded to Controllers. Prior to on-line operation a complete demonstration and readout of the computer command shall be performed in the presence of the Owner. In addition, a printout of the data base generated for all points shall be reviewed with the Owner by the EMCS contractor. Modification to the data base shall be made by the EMCS contractor as directed by the Owner.

C. All points shall be verified prior to "punch-out" for correct and accurate correspondence between the CRT data display and actual field location and equipment operation.

D. The Contractor shall maintain dated and initialed calibration and verification sheets and provide a copy to the Owner. Include verification of enhanced alarming with messages for all points selected by the Owner. Typical points with messages include control air compressors, 24 hour fans and pumps, critical systems and animal areas. Point verification sheets can be obtained in Central Control.

E. Upon successful completion of system generation the Owner shall be requested in writing to inspect and approve the satisfactory operation of the EMCS, sub-systems, and accessories.

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.

B. Coordination start up of the system with the RTU (AC UNIT) manufacturer.

END OF SECTION 230923
SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall round and flat-oval ducts and fittings.
   4. Sealants and gaskets.
   5. Hangers and supports.

B. Related Sections:
   1. Division 23 Section “Testing, Adjusting, and Balancing for HVAC” for testing, adjusting, and balancing requirements for metal ducts.
   2. Division 23 Section “Air Duct Accessories” for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule” Article unless otherwise indicated.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible”

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:
   1. Sealants and gaskets.
B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Standing seams T-15, angle reinforced standing seams T-16, welded flange T-21, reinforced welded flange T-21a, companion angles T-22, and formed-on flanges T-25a (TDC) and T-25b (TDF)
2. Use of drives slip seams on sides is acceptable for unreinforced ducts.
3. Use of tie rodded reinforcement alternative is not acceptable.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. All longitudinal seams on flat sides shall be of the grooved seam L-3.
2. All longitudinal corner seams shall be of the Pittsburgh lock L-1.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Smooth radius with at least one splitter vane and square throat R/W equal to 0.5 or higher.
2. Mitered and Tee-shape elbows with turning vanes are acceptable where space restrictions dictate.
3. Select 45 degree entry tees, conical or bell mouth tees, or wyes. Straight tap connections will not be accepted.

E. As an option, Ductmate proprietary duct connection systems may be used with permission of the Architect/Engineer. Refer to the manufacturer guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. McGill AirFlow LLC.
   b. SEMCO Incorporated.
   c. RW LaPine.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
   2. Lap at least 2 inches in direction of air flow and securely fastened with screws through the lap on center spacing not to exceed 2 ½ inches.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Fabricate round ducts larger than 90 (2286 mm) inches in diameter with butt-welded longitudinal seams.
   2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Elbows: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," unless otherwise indicated.
   1. Smooth radius stamped elbows for 8" ducts and smaller. 5-piece segmented elbows for 9" duct and larger.
   2. Elbows shall have a centerline radius at least equal to 1.0 times the duct diameter. Mitered elbow will not be accepted.

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 3 inches (76 mm).
   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 degree C).
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Base: Synthetic rubber resin.
   4. Solids Content: Minimum 60 percent.
   5. Shore A Hardness: Minimum 60.
   7. Mold and mildew resistant.
   8. VOC: Maximum 395 g/L.
   9. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
   10. Service: Indoor or outdoor.
   11. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
E. Flanged Joint Sealant: Comply with ASTM C 920.
   2. Type: S.
   3. Grade: NS.
   5. Use: O.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS


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:
   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 round and flat-oval ducts in maximum practical lengths.
D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.


M. Use fabricated fittings for all changes in directions, sizes, shapes and connections.

N. Locate ducts parallel and perpendicular to building lines; avoid diagonal runs except as otherwise indicated.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.
3.3 DUCT SEALING

A. Seal NEW and EXISTING ducts for duct static-pressure, seal classes, and leakage classes specified in “Duct Schedule” Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing.

1. Install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
2. Install hangers at duct joints on either 8 or 10 foot centers, and at every change of direction.
3. Support ductwork directly from the building structure; not from the other ducts, piping, equipment, or roof deck.
4. Holes shall not be drilled or punched in beams and supporting members.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.
3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   2. Test the following systems:

3.7 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.
   1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section “Air Duct Accessories” for access panels and doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
   2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
   7. Dedicated exhaust and ventilation components and makeup air systems.
E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.8 START UP

A. Air Balance: Comply with requirements in Division 23 Section “Testing, Adjusting, and Balancing for HVAC.”

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: C.

2. Ducts Connected to Constant-Volume Air-Handling Units:
   a. Pressure Class: Positive 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: B.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
   a. Pressure Class: Positive 4-inch wg (1000 Pa).
   b. Minimum SMACNA Seal Class: A.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: C.
2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: B.

D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 3-inch wg (750 Pa).
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
   2. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
      a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
      b. Minimum SMACNA Seal Class: C.
   2. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
      b. Minimum SMACNA Seal Class: B.
   3. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive or negative 2-inch wg.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 3.
         SMACNA Leakage Class for Round and Flat Oval: 3.

F. Intermediate Reinforcement:
   2. PVC-Coated Ducts:
      a. Exposed to Airstream: Match duct material.
      b. Not Exposed to Airstream: Match duct material.
   3. Stainless-Steel Ducts:
      a. Exposed to Airstream: Match duct material.
      b. Not Exposed to Airstream: Galvanized.

Elbow Configuration:
   4. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
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a. Velocity 1000 fpm (5 m/s) or Lower:
   1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
   2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
   1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
   2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm (7.6 m/s) or Higher:
   1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

5. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

6. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm (5 m/s) or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm(5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to-Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connections."
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a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
   c. Velocity 1500 fpm (7.6 mm) or Higher: 45-degree lateral.

END OF SECTION 233113
SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Backdraft and pressure relief dampers.
   3. Fire dampers.
   4. Flange connectors.
   5. Turning vanes.
   6. Remote damper operators.
   7. Duct-mounted access doors.
   8. Duct access panel assemblies.
  10. Flexible ducts.
  11. Duct accessory hardware.

B. Related Sections:
   1. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      c. Control damper installations.
      d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

D. Source quality-control reports.

E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE


B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.


E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance Inc.; a division of Mestek, Inc.
2.  Greenheck Fan Corporation.
3.  American Warming.
4.  Perfco.

B.  Description: Gravity balanced.

C.  Maximum Air Velocity: 2000 fpm (10 m/s).

D.  Maximum System Pressure: 1-inch wg (0.25 kPa).

E.  Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners and mounting flange.

F.  Blades: Multiple single-piece blades, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.

G.  Blade Action: Parallel.

H.  Blade Seals: Extruded vinyl, mechanically locked.

I.  Blade Axles: Aluminum.

J.  Tie Bars and Brackets: Aluminum.

K.  Return Spring: Adjustable tension.

L.  Bearings: Synthetic pivot bushings.

M.  Accessories:

1.  Adjustment device to permit setting for varying differential static pressure.
2.  Counterweights and spring-assist kits for vertical airflow installations.
3.  Electric actuators.
4.  Chain pulls.
5.  Screen Mounting: Front or rear mounted in sleeve as indicated.
7.  Screen Type: Bird.
8.  90-degree stops.

2.3  MANUAL VOLUME DAMPERS

A.  Standard, Steel, Manual Volume Dampers:

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

   a.  Air Balance Inc.; a division of Mestek, Inc.
   b.  Greenheck.
   c.  American Warming.
   d.  Perfco.

2.  Standard leakage rating, with linkage outside airstream.
3.  Suitable for horizontal or vertical applications.
4.  Frames:
a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62 mm) minimum thickness.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 (1.62 mm) inch thick.


7. Bearings:
   a. Oil-impregnated bronze or molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch (750 Pa) wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:
   1. Size: 1-inch (25 mm) diameter.
   2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:
   1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch (2.4 mm) thick zinc-plated steel, and a 3/4-inch (19 mm) hexagon locking nut.
   2. Include center hole to suit damper operating-rod size.
   3. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

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

   1. Air Balance Inc.; a division of Mestek, Inc.
   2. Greenheck Fan Corporation.
   3. American Warming.
   4. United Enertech.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch (1 kPa) wg static pressure class and minimum 4000-fpm (20 m/s) velocity.

D. Fire Rating: 1-1/2 hours.
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1/28/15

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
   1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
   2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch (0.85 mm) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034 (0.85 mm) inch-thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.


K. Accessories:
   1. Auxiliary switches for signaling fan control or position indication.
   2. Test and reset switches, remote mounted.

2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Nexus PDQ; Division of Shilco Holdings Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. METALAIRE, Inc.
   3. SEMCO Incorporated.
B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.


D. Vane Construction: Double wall.

2.7 REMOTE DAMPER OPERATORS

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

1. Ventfabrics, Inc.
2. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed, 3/4 inches (19 mm) deep.

F. Wall-Box Cover-Plate Material: Steel.

2.8 DUCT-MOUNTED ACCESS DOORS

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

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Ductmate Industries, Inc.
3. Flexmaster U.S.A., Inc.
5. McGill AirFlow LLC.
6. Nailor Industries Inc.


1. Door:

   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
   d. Access Doors Larger than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:
   1. Door and Frame Material: Galvanized sheet steel.
   2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
   3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
   4. Factory set at 10-inch wg (2500 Pa).
   5. Doors close when pressures are within set-point range.
   6. Hinge: Continuous piano.
   7. Latches: Cam.
   8. Seal: Neoprene or foam rubber.
   9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.9 DUCT ACCESS PANEL ASSEMBLIES
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Flame Gard, Inc.
   3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.10 FLEXIBLE CONNECTORS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
2. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

   1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
   2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

   1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
   2. Minimum Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
   1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
   2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.11 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. McGill AirFlow LLC.
   2. RW Lapine.

B. Acoustical, Insulated, Flexible Duct: UL 181, Class 1, CPE inner film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a
      worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

2.12 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap
   and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to
   suit duct-insulation thickness.
B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline
   and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA’s “HVAC Duct Construction
   Standards - Metal and Flexible” for metal ducts and in NAIMA AH116, “Fibrous Glass Duct
   Construction Standards,” for fibrous-glass ducts.
B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories
   in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts,
   and aluminum accessories in aluminum ducts.
C. Install dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan
   unless otherwise indicated.
D. Install volume dampers at points on supply, return, and exhaust systems where branches
   extend from larger ducts.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.
   3. Do not use extractors, splitter-type dampers, and register or diffuser dampers for volume
      control.
   4. Locate volume dampers at least two diameters from a fitting and as far as possible from
      outlets.
E. Set dampers to fully open position before testing, adjusting, and balancing.
F. Install test holes at fan inlets and outlets and elsewhere as indicated.
G. Install fire and smoke dampers according to UL listing.
H. Connect ducts to duct silencers rigidly.
I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot (15-m) spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Upstream from flow measuring stations.
12. Upstream from steam humidifiers.
13. In duct below roof ventilators or fans to service dampers.
14. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).

L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Connect diffusers or light troffer boots to ducts with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands.

Q. Install duct test holes where required for testing and balancing purposes.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.
3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300
SECTION 234100 - PARTICULATE AIR FILTRATION

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. Pleated panel filters.
   2. Self-supported pocket filters (bag filter).
   3. Front- and rear-access filter frames.
   4. Side-service housings.
   5. Filter gages – magehelic for each filter bank.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.
   1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
   2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
   3. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

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

B. ASHRAE Compliance:

C. Comply with NFPA 90A and NFPA 90B.
1.5 COORDINATION

1.6 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. Provide one complete set(s) of filters for each filter bank for both pre and final filters.

PART 2 - PRODUCTS

2.1 PLEATED PANEL FILTERS

A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.

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

   a. AAF International.
   b. Airguard.
   c. Camfil Farr.
   d. Flanders-Precisionaire.

B. Filter Unit Class: UL 900, Class 2.

C. Media: Cotton and synthetic fibers coated with nonflammable adhesive.

D. Filter-Media Frame: Cardboard frame with perforated metal retainer with metal grid on outlet side and steel rod grid on inlet side, hinged, with pull and retaining handles sealed or bonded to the media.

E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

F. Characteristics:

   1. Face Dimensions: 24 x 24 inches or 12 x 24 inches.
   2. Thickness or Depth: 2 inches (50 mm).
   3. Maximum or Rated Face Velocity: 500 fpm.
   5. Average Arrestance, %: N/A
   6. Initial Resistance: 0.30-inch wg (74 Pa) at 500 fpm (2.5 m/s).
   7. Recommended Final Resistance: 1 inches wg.

2.2 SELF-SUPPORTED POCKET FILTERS

A. Description: Factory-fabricated, panel-type, disposable air filters with contoured media for extended surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fiberbond Corp.; Multi-Wedge.

B. Filter Unit Class: UL 900, Class 1.

C. Media: Non-carcinogenic, non-shedding synthetic fiber, bonded with a flame retardant binder system.
   1. Media shall be coated with an antimicrobial agent.

D. Configuration: Multipocket.

E. Filter-Media Frame: Galvanized steel.

F. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

G. Capacities and Characteristics:
   1. Face Dimensions: 24 x 24, 24 x 12 or 12 x 24 inches.
   2. Maximum or Rated Face Velocity: 500 fpm.
   3. Average Arrestance, %: N/A.
   4. Initial Resistance: 0.5 inches wg (Pa).
   5. Recommended Final Resistance: 1.0 inches wg (Pa).

2.3 FRONT- AND REAR-ACCESS FILTER FRAMES

A. Framing System: Galvanized-steel framing members with access for either upstream (front) or downstream (rear) filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AAF International.
   b. Airguard.
   c. Camfil Farr.
   d. Flanders-Precisionaire.
   e. Koch Filter Corporation.

B. Prefilters: Incorporate a separate track with slide in system.

C. Sealing: Factory-installed, positive-sealing device for each row of filters, to ensure seal between gasketed filter elements and to prevent bypass of unfiltered air.

2.4 SIDE-SERVICE HOUSINGS

A. Description: Factory-assembled, side-service housings, constructed of galvanized steel with flanges to connect to duct or casing system.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AAF International.
   b. Airguard.
   c. Camfil Farr.
   d. Flanders-Precisionaire.
   e. Koch Filter Corporation.

B. Prefilters: Integral tracks to accommodate 2-inch- (50-mm-) deep, disposable filters.

C. Access Doors: Hinged, with continuous gaskets on perimeter and positive-locking devices, and arranged so filter cartridges can be loaded from either access door.

D. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames and to prevent bypass of unfiltered air.

2.5 FILTER GAGES

A. Diaphragm-type gage with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dwyer Instruments, Inc.
   b. Magnehelic.

2. Diameter: 4-1/2 inches (115 mm).

3. Scale Range for Filter Media Having a Recommended Final Resistance of 1.0- to 2.0-Inch wg (250 to 500 Pa) or Less: 0- to 2.0-inch wg (0 to 500 Pa).

B. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

B. Install filters in position to prevent passage of unfiltered air.

C. Install filter gage for each filter bank. The gauge shall be mounted on the air handler, near the filter bank, in a convenient location for reading from the floor.

D. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.

E. Coordinate filter installations with duct and air-handling-unit installations.
F. Provide brass tag, mounted near filter gauge, indicating size, flow rate, initial and final pressure drops, efficiency and fire classification for each type of filter.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test for leakage of unfiltered air while system is operating.

C. Air filter will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media. (This filter change shall not be the “attic stock” filters.

END OF SECTION 234100
SPECIFICATION (Unit to be Prepurchased and assigned to the contractor)

1 General

1.1 Scope

A. The requirements of the General Conditions, Supplementary Conditions, Division 1 and drawings apply to all work herein.

B. Provide microprocessor controlled, multiple-scroll compressor, air-cooled double-wall outdoor packaged rooftop air conditioning units, and components ofps

C. the scheduled capacities and performance as shown and indicated on the drawings, including but not limited to: factory-single packaged air conditioner, charge of refrigerant and oil, roof curb, field duct, power and control connections, and utility connections.

1.2 Quality Assurance

A. All units are tested, rated or certified, as applicable, in accordance with the following standards, guidelines and codes:

1. All units shall meet the latest ASHRAE 90.1 minimum energy-efficiency requirements (EER)

2. All units shall meet the latest ASHRAE 62 requirements for ventilation and indoor air quality.

3. All units shall be rated in accordance with the ARI Standard 340/360

4. Units shall be ETL and ETL Canada listed

B. Manufacturers: The design shown on the drawing is based upon products of one of the following manufacturers:

1. Carrier

2. Trane


4. Components:
   a. Structural support base.
   b. Electrical power requirements and wire/conduit and overcurrent protection sizes.
   c. All costs incurred to modify the building provisions to accept the furnished units.

C. Warranty: Manufacturer shall warrant all equipment and material of its manufacture against defects in workmanship and material for a period of twenty four (24) months from date of installation and start up of the last unit.

1. The warranty shall include parts and labor only during this period.

2. The warranty shall not include parts associated with routine maintenance, such as belts, air filters, etc.

3. Compressor warranty (Material Only) shall be 5 years (with 2 years of parts and labor noted in item C above)

1.3 Delivery and Handling

A. Unit shall be delivered to the job site fully assembled, wired, and charged with refrigerant and oil by the manufacturer.

B. Unit shall be stored and handled per Manufacturer’s instructions.
C. All handling and storage procedures shall be per manufacturer’s recommendations.

1.4 Submittals

A. Shop Drawings: Shop drawing submittals shall include, but not limited to, the following: drawings indicating components, dimensions, weights, required clearances, and location, type and size of field connections, and power and control wiring connections.

B. Product Data: Product data shall include dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.

C. Documentation:
   1. Fan curves with specified operating point clearly plotted shall be provided.
   2. Product data of filter media, filter performance data, filter assembly, and filter frames shall be provided.
   3. Electrical requirements for power supply wiring; including wiring diagrams for interlock and control wiring shall be supplied. Factory and field-installed wiring shall be clearly indicated.

D. Operation and Maintenance Documentation
   1. Manufacturer’s standard operating and maintenance instructions shall be supplied including but not limited to instructions for lubrication, filter replacement, compressor, motor and drive replacement, coil cleaning, filter maintenance, spare parts lists, and wiring diagrams.

2 Equipment

2.1 Product Specification

A. Summary: Completely factory assembled unitized construction single packaged air conditioning unit including a factory-mounted and wired unit controller and sensors, Single-Point Power with Non-fused Disconnect, 460V-3Ph-60Hz power supply, outdoor air handling section with return and supply openings, discharge plenum, direct-expansion refrigerant condensing section. 5kA SCCR The unit shall be provided with 5kA SCCR equipment rating as standard. The unit nameplate will reflect this rating

B. Phase Monitor: A phase monitor shall be provided on unit; designed to protect 3-phase equipment from phase loss, reversal, imbalance, and low voltage. The phase monitor fault condition is indicated at the unit control panel and the unit is placed into an emergency stop condition.

C. Factory Test: On factory assembled units, the refrigerant circuit shall be helium pressure-tested, evacuated and fully charged with refrigerant and oil. On factory assembled units, the unit controller shall be configured and run tested at the factory to minimize field setup time. If the unit is not configured and tested, then the manufacturer shall provide field start up and testing to ensure that the controller is functioning properly.

D. Unit Construction
   1. Base Rail: The unit shall include an integral design base rail with lifting points clearly marked and visible on the base rail and a 1-1/4” FPT connection for condensate drainage. The unit base shall be designed with a recessed curb mounting location. The recessed curb-mounting surface shall provide a continuous surface for field application of curb gasketing to create a weather tight seal between the curb and unit.

   2. Casing: Casing shall be complete post and panel construction with exterior skin. All panels, doors, walls, uprights, floor panels and roofing shall be one-inch thick; 1-1/2 pound density insulation. Units are specifically designed for outdoor installation.
3. Roof: The unit roof shall be bowed with the peak in the middle of the unit and sloped to both sides of the unit for drainage. A drip lip shall run the length of the unit to prevent water drainage down the side of the unit. Roof and sidewall seams shall be continuously caulked and covered with formed galvanized seam caps. All panel fasteners shall be secured through standing seams to prevent fastener penetrations that are exposed to the air stream.

4. Paint: Exterior painted surfaces are designed to withstand a minimum of 500 salt spray hours when tested in accordance with ASTM B-117.

5. Markings and Diagrams: All necessary tags and decals to aid in the service and/or indicating caution areas shall be provided. Electrical wiring diagrams shall be attached to the control panel access door.

6. Documentation: Installation and maintenance manuals shall be supplied with each unit.

E. Access Doors: Double wall access doors shall be provided in the fan, coil, filter and inlet sections of the unit on both sides of the unit. Doors shall be double-wall construction with a solid liner and a minimum thickness of 1-inch. Doors shall be attached to the unit with piano-type stainless steel hinges. Latches shall be single handle rotary type with 3 point contact, creating an airtight seal between the door and unit. Panels and doors shall be completely gasketed with a closed-cell, neoprene gasket. Door tiebacks shall be provided for all doors to secure doors while servicing.

F. Economizer Section.

1. Modulating Economizer: The economizer segment shall be designed to use outside air for cooling and ventilation and provide a means of exhausting air from the air-handling unit. The segment shall consist of parallel acting low-leak dampers. The return air, outside air and exhaust air dampers shall be sized for 100% of nominal unit airflow. The exhaust air damper assembly shall have a factory-assembled rain hood. The rain hood shall have a drip-lip the full width of the hood to channel moisture away from the air being drawn into the unit.

2. Power Return Fan - A SWSI plenum fan shall be provided to draw return air from the building to the single packaged unit. An access door shall be provided on at least one side of the unit for fan/motor access. The return fan shall operate to maintain a constant pressure within the return plenum. A discharge damper shall be provided to modulate building exhaust. The damper shall be controlled via building pressure. The return damper shall linked with the outside air damper to modulate volumes of return and outside airflows.

   a. Fan Motor: Fan motors shall be NEMA design ball-bearing types with electrical characteristics and horsepower as specified. Motors shall be nominal 1750 RPM, open drip-proof type. The motor shall be located within the unit on an adjustable base.

   b. Mountings: Fan and fan motor shall be internally mounted and isolated on a full width isolator support channel using 2-inch springs. The fan discharge shall be connected to the fan cabinet using a flexible connection to insure vibration-free operation.

   c. Bearings and Drives: Fan bearings shall be self-aligning, pillow block or flanged type regreaseable ball bearings and shall be designed for an average life (L50) of at least 200,000 hours. All bearings shall be factory lubricated and equipped with standard hydraulic grease fittings and lube lines extended to the motor side of the fan. Fan drives shall be selected for a 1.5 service factor and anti-static belts shall be furnished. All drives shall be fixed pitch. Fan shafts shall be selected to operate well
below the first critical speed and each shaft shall be factory coated after assembly with an anti-corrosion coating.

d. VAV Fan Control: VAV supply fan control shall be accomplished by using a variable-frequency-drive matched to the supply fan motor HP. The VFD shall include an integral DC line reactor to reduce harmonic distortion in the incoming and outgoing power feeds. If a DC line reactor is not provided, an AC line reactor must be provided. Inlet guide vanes shall not be acceptable. VFD control keypads shall be located in the control cabinet for accessibility and servicing while the unit is operating.

Filter Section.

1. Flat Filter Rack: 85% Efficient Rigid Filters with a two-inch high-efficiency pleated pre-filters (MERV 14) shall be provided in a flat filter rack.

2. Dirty Filter Alarm: A dirty filter switch shall be provided and wired to the single packaged unit control panel. Upon closure of the switch, the controller shall display a dirty filter fault. The setting of the switch can be changed manually to close at a specified pressure drop across the filters.

3. See filter specification section.

G. Evaporator Section

1. Cooling Coil: Evaporator coils shall be direct expansion type with intertwined circuiting to assure complete coil face activity during part load operation. Coil tubes shall be 1/2” OD copper, with internally enhanced tubes. Tubes shall be enhanced mechanically expanded to bond with the aluminum fins. Coil casing shall be fabricated from heavy gauge galvanized steel. All coils shall be pressure tested at a minimum of 450 PSIG.

2. IAQ Drain Pan: The main coil drain pan shall be double-sloped Stainless Steel with a condensate connection through the base rail of the unit.

3. Intermediate Drain Pan: Coils with finned height greater than 48” shall have an intermediate drain pan extending the entire finned length of the coil. The intermediate pans shall have drop tubes to guide condensate to the main drain pan.

H. Supply Fan Section

1. Fan Motor: Fan motors shall be NEMA design ball-bearing types with electrical characteristics and horsepower as specified. Motors shall be nominal 1750 RPM, open drip-proof type ODP - Premium Efficiency. The motor shall be located within the unit on an adjustable base.

2. Fan: The fan section shall be equipped with a single double width, double inlet (DWDI) airfoil centrifugal type wheels for horizontal discharge. An access door shall be provided on both sides of the unit for fan/motor access.

3. Mountings: Fan and fan motor shall be internally mounted and isolated on a full width isolator support channel using 2-inch springs. The fan discharge shall be connected to the fan cabinet using a flexible connection to insure vibration-free operation.

4. Bearings and Drives: Fan bearings shall be self-aligning, pillow block or flanged type regreaseable ball bearings and shall be designed for an average life (L50) of at least 200,000 hours. All bearings shall be factory lubricated and equipped with standard hydraulic grease fittings and lube lines extended to the motor side of the fan. Fan drives shall be selected for a 1.5 service factor and anti-static belts shall be furnished. All drives shall be fixed pitch. Fan shafts shall be selected to operate well below the first critical speed and each shaft shall be factory coated after assembly with an anti-corrosion coating.
5. VAV Fan Control: VAV supply fan control shall be accomplished by using a variable-frequency-drive matched to the supply fan motor HP. The VFD shall include an integral DC line reactor to reduce harmonic distortion in the incoming and outgoing power feeds. If a DC line reactor is not provided, an AC line reactor must be provided. Inlet guide vanes shall not be acceptable. VFD control keypads shall be located in the control cabinet for accessibility and servicing while the unit is operating.

I. Discharge Plenum
1. Cooling Only

The discharge air temperature sensor shall be located in the discharge plenum and be located such that it accurately measures the supply air temperature.

J. Condenser Section
1. Condenser Fans: Condenser fans shall be matched up with compressors to optimize system control. Condenser fans shall be propeller type, directly driven by permanently lubricated TEAO motor.

2. Condenser Coil: Microchannel condenser coils shall be constructed of parallel flow copper tubes metallurgically brazed to enhanced aluminum alloy fins. Coils are configured in a V-bank configuration, with individual flat coils rotated from the vertical plane for protection from hail damage for each condensing circuit. Condensing coils shall have a subcooler for more efficient, stable operation.

3. Low Ambient: Compressors shall operate down to 0°F by monitoring the refrigeration system discharge pressure and adjusting condenser airflow to maintain the proper head pressure to protect compressor operation. Refrigerant pressure transducers shall be included and provide the discharge pressure on the single packaged unit control display.

4. Service Valves: Liquid, suction and discharge service valves shall be included to provide a means of isolating the refrigerant charge in the system so that the refrigeration system may be serviced without removing the charge of the unit.

5. Compressors: Units shall use industrial-duty hermetic scroll compressors, piped and charged with oil and HFC-410A refrigerant. Compressors shall have an enlarged liquid carrying capacity to withstand rugged operating conditions. Compressor frame shall be cast iron, with cast iron fixed and orbiting scrolls. Each compressor shall feature a solid state protection module, designed to protect the compressor from over-temperature and over-current conditions. Compressors shall be vibration-isolated from the unit, and installed in an easily accessible area of the unit. All compressor-to-pipe connections shall be brazed to minimize potential for leaks. Each compressor shall include a replaceable suction screen, discharge line check valve, and oil sight glass.

6. In-Line Refrigerant Driers: Refrigerant piping includes check valves, thermal expansion valves with replaceable thermostatic elements, high and low pressure switches, anti-recycling timing device to prevent compressor restart for five minutes after shutdown.

7. Freezestat: Freezestats shall be provided to prevent coil freeze up and reduce the risk of liquid flood-back to the compressor.

8. Condenser enclosure: The condenser section shall be enclosed by a Wire grill condenser enclosure on the three exposed sides. Paint finish shall match the color and salt spray specifications of the unit exterior.

K. Controls
1. Enclosure: Unit shall be shipped complete with factory configured, installed, wired and tested single packaged unit controller housed in a rain and dust tight NEMA 3R/12 (IP55) powder painted steel cabinet with hinged, latched, and gasket sealed door.

2. Compressor Capacity Modulation: Unit shall include six compressors of varying size to provide 14 to 100% cooling capacity control during normal operation. The compressor sequence of operation shall reduce typical temperature change to less than 2 F° at the unit discharge at full design air flow. Unit shall not require hot gas bypass and the inherent energy usage it requires to properly operate the unit. Upon entering cooling mode from other modes, the unit controller will estimate the cooling requirement and match it closely to the capacity in order to reduce the time required to satisfy the cooling requirements. After the initial calculation, the unit controller will add or reduce stage(s) as necessary to establish a balance between the unit capacity and the space cooling load.

3. Basic Controls: BACNet compatible – see drawings. Control shall include automatic start, stop, operating, protection sequences across the range of scheduled conditions and transients. The single packaged unit controller shall provide automatic control of compressor start/stop, energy safer delay and anti-recycle timers, condenser fans, and unit alarms. Automatic reset to normal operation after power failure. Software stored in non-volatile memory, with programmed set points retained in lithium battery backed real time clock (RTC) memory for minimum 5 years. An eighty character liquid crystal display shall be provided to show all descriptions and numeric data in English (or Metric) units. A sealed, membrane style keypad, with no less than 36 keys, shall be used to navigate the controller and enter data. Provide power voltage (bump) projection of controls and unit components.

4. Diagnostics: Upon startup of the controller, it shall run through a self-diagnostic check to verify proper operation and sequence loading. The single packaged unit controller shall continually monitor all input and output points on the controller to maintain proper operation. The unit shall continue to operate in a trouble mode or shut down as necessary to prevent an unsafe condition for the building occupants, or to prevent damage to the equipment. In the event of a unit shutdown or alarm, the operating conditions, date and time shall be stored in the shutdown history to facilitate service and troubleshooting. A minimum of ten (10) Error Histories shall be recorded.

5. BAS Communications
   a. BACnet MSTP (RS-485): The unit shall include BACnet communications directly from the unit controller. Equipment that is not native BACnet at the unit control board shall include any necessary interface or translator device factory-mounted and wired within the unit. Twisted Pair connection. A control points list, BIBBs and PICS statement shall be provided by the manufacturer to facilitate communications programming with the building automation system. Programming, establishing communications and commissioning shall be the responsibility of the installing controls contractor. Start-up Services are required for each individual unit and then as a separate additional meeting with the temperature control supplier of the Building System.
   b. Generic Hard-Wired BAS Interface: An interface shall be provided that provides an interface to any building automation system via hardwired connections. At a minimum, the interface shall provide the following inputs and outputs:
   c. Inputs: supply air reset, duct static pressure reset, smoke purge operating mode and morning warm-up
Outputs: fault alarms for sensors

3 Execution

3.1 Installation:

A. General: Installing contractor shall install single packaged unit(s), including components and controls required for operation, in accordance with single packaged unit manufacturer’s written instructions and recommendations. Single packaged units shall be installed as specified.

1. Unit(s) specified shall include a protective covering membrane for such equipment being shipped by truck, rail, or ship. The membrane is fully formed around the equipment exterior. The membrane covers the entire top, side and end panel surface as to protect the product effectively during shipping & storage including “Long Term Storage”. Storing on job-site shall no longer require the unit(s) to be covered with a tarp as long as the covering membrane has not been removed.

2. All size or shape equipment including electrical components, especially those not built with weatherproof enclosures, variable-frequency drives and end devices shall be effectively covered for protection against rain, snow, wind, dirt, sun fading, road salt/chemicals, rust, and corrosion during shipping cycle. Equipment shall remain clean and dry.

3. Manufacturers of units not having a protective membrane, fully formed around the equipment exterior, covering the entire top, side and end panel surface area shall be required to ship equipment covered with a tarp, in crating or in a closed truck as is necessary to ensure product protection from road salt/chemicals damage, moisture and dirt infiltration. Arrangements for long term storage at the job site shall be required.

B. Location: Locate the single packaged unit as indicated on drawings, including cleaning and service maintenance clearance per Manufacturer instructions. Adjust and level the single packaged unit on support structure.

3.2 Inspection and Start-Up Supervision: A factory-trained service representative of the manufacturer shall supervise the unit startup and application specific calibration of control components. Installation and start up services are to be provided on each unit individually due to a phased installation. During unit commissioning, by the mechanical contractor, BACNet specialist shall be present. Commissioning is expected to be 2-days per phase, 10 days total.
SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to Divisions 26 Sections, in addition to General Conditions, Supplementary Conditions, Division 1 and Division 2.

B. Drawings and all electrical sections apply to each section of the electrical specifications.

1.02 SUMMARY

A. It is mandatory that all electrical trades work required for the complete installation must accommodate Owner’s access to his daily operation. Coordinate work schedule with Architect/Engineer and Owners representative.

1.03 WORK INCLUDED

A. The work shall include, but shall not be limited to the following:

1. The demolition necessary to accommodate new work and new construction.

2. The provision of all separate motor controls including disconnect switches, as required for all mechanical and/or owner furnished equipment.

3. The provision of receptacle outlets as indicated or required.

4. The provision of raceway, boxes, rough in, etc., including pull wire for all devices.

5. The disconnect of all mechanical equipment as shown on mechanical and electrical documents including the removal of conduits and wiring back to source.

6. The provision of exterior lighting.

7. The provision of duct smoke detectors connected to new fire alarm panel.

8. The provision of all new typewritten directory in existing panelboard.

9. All steel supports required for the installation of electrical equipment, conduits, metal raceways, lighting fixtures and elsewhere as required for complete installation.

10. All cutting and patching work required for the electrical installation, unless noted otherwise.

11. Acceptance testing for all new electrical systems and equipment.

12. All incidental items required to complete the installation.

13. The provision of temporary power as described in Division 1.

14. Replacement of existing Simplex Fire Alarm panel with new Simplex Fire Addressable Fire Alarm Panel. Exact location and required/additional quantity of devices shall be the responsibility of the system provider/installing contractor to meet manufacturer’s recommendations, field conditions, and applicable code requirements).
15. Provide testing and re-commissioning of fire alarm system.

16. Installation and final termination of new DDC controls wiring for the Student Center Building 6th floor shall be by electrical trades. DDC controls programming and commissioning shall be by Siemens. (WSU authorized control system provider).

1.04 REFERENCES


1.05 SUBMITTALS

A. Submit under provisions of Section 01700.

B. Proposed Products List: Include Products specified in the following sections:

- Section 260100 Basic Electrical Requirements
- Section 260500 Common Work Results For Electrical
- Section 260519 Low-Voltage Electrical Power Conductors And Cables
- Section 260526 Grounding And Bonding For Electrical Systems
- Section 260529 Hangers And Supports For Electrical Systems
- Section 260533 Raceway And Boxes For Electrical Systems
- Section 260553 Identification For Electrical Systems
- Section 260923 Lighting Control Devices
- Section 262416 Panelboards
- Section 262726 Wiring Devices
- Section 262813 Fuses
- Section 262816 Enclosed Switches And Circuit Breakers
- Section 270500 Common Work Results For Communications

C. Submit shop drawings and product data grouped to include complete submittals of related equipment and accessories in a single submittals.

D. Mark dimensions and values in units to match those specified.

E. Upon completion of project contractor shall provide Owner with one set of complete Mylar Transparency record drawings of the underground lighting, power, fire alarm, security, telecommunication and audio/visual systems.

1.06 REGULATORY REQUIREMENTS

A. All applicable ANSI, NFPA, State, County, City and local codes and ordinances.

B. Obtain and pay for all required permits.

C. Request inspections from authority having jurisdiction.

1.07 PROJECT/SITE CONDITIONS

A. Install work in locations shown on drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other Sections. Obtain permission of Architect/Engineer before proceeding.

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1.08 SEQUENCING AND SCHEDULING
   A. Construction work in sequence under provisions directed by Architect.

1.09 WIRING METHODS
   A. Provide raceways for all wiring. Wiring shall not be run exposed or concealed without being enclosed in raceways.
   B. Do not mix wiring systems. Provide separate raceways for different systems by Voltage, type or purpose.
      1. 120/208 volt separate from 277/480 volts.
      2. Exit and means of egress lighting separate.
      3. Tele/comm/data/separate.
      4. Fire alarm.

1.10 WORK NOT INCLUDED OR WITH OWNER TRADES
   The following work will not be part of the electrical work:
   A. Furnishing and installation of all building motors.
   B. The Architectural and Mechanical Trades control system wiring except 120 volt line circuit wiring to equipment such as unit heaters and domestic hot water circulating pumps.
   C. "Package Unit" equipment, and similar items, will be furnished with starters and control devices by the Mechanical Trades unless otherwise shown on M & E Coordination Schedule. Electrical Trades shall make incoming line power connections only to the motor starter or controller, as required, or indicated.
   D. The mechanical contractor will supply the variable frequency drives pre-wired to units. Electrical contractor shall make final line connections only.

1.11 ELECTRICAL SERVICE
   A. Secondary Service: 480Y/277 VAC, 3 phase, 4 wire, from existing panelboards.
   B. Motorized Equipment Rated 1/2 H.P. and Larger: 480 VAC, 3 phase, 3 wire.
   C. Fluorescent and LED Lighting: 480/277 VAC, 3 phase 4 wire, from lighting panels.
   D. Receptacles, and Small Power System: 208Y/120 VAC, 3 phase, 4 wire.
1.12 DEFINITIONS

A. In the Electrical sections of Specifications, the terms "Electrical Trades", "The Contractor", or "This Contractor" shall mean the Electrical Contractor. The term “Provide” shall mean “furnished and installed in place.”

1.13 INSPECTION OF SITE

A. Before submitting his proposal, this Contractor shall personally inspect the site of the proposed work to arrive at a clear understanding of the conditions under which work is to be done. He shall be held responsible to have compared the premises and site with the Drawings and Specifications and to have satisfied himself as to conditions of the premises, existing obstructions and any other conditions affecting the carrying out of this work, before the delivery of his proposal.

B. No allowances or extra consideration in behalf of the Contractor will subsequently be allowed because of error or failure on the part of the Contractor in making such inspection.

1.14 EXCAVATION AND BACKFILLING

A. All excavation and backfilling required to install work specified in the Electrical Division shall be done by the Contractor for excavation work, but paid for by this Contractor.

1.15 DEMOLITION

A. As shown on plans, certain areas in the existing building shall be modified to suit the new requirements.

B. Work in the area includes the disconnection, removal relocation and complete reconnection of all items shown on plans and/or otherwise required to suit the design intent. It shall be the responsibility of the contractor to visit the job site to correctly ascertain the scope of work and to include all pertinent costs in his base bid.

C. Relocate and reroute equipment, devices and wiring as required in demolition areas.

D. All electrical work interfering with modification work for the new requirements shall be disconnected, removed, and/or rerouted to suit the final installation.

E. Removal shall mean complete disconnection and removal of electrical work and material, normally provided by electrical trades, including such items as disconnect switches, control devices, etc., conduit and wire to source.

F. Source shall mean panel or existing item to remain.

G. Relocation shall mean complete disconnection, relocation and reconnection of electrical work and material, normally provided by electrical trades, including such items as disconnect switches, control devices, etc., and extension of existing and/or provision of new conduit and wiring, from source.

H. All equipment and wiring not in renovation areas but affected by work in renovation areas shall be reconnected as necessary for the complete working system.

I. Abandoned and inactive conduits, wire, devices, equipment, etc., on walls shall be removed in their entirety. Above new ceilings, existing lighting fixtures shall be removed. Conduit and boxes shall be removed. Conduit and wiring feeding devices, and equipment to be removed shall be
also removed up to the next active pull box, junction box or panel, hangers, messenger cable, brackets, etc., supporting items to be removed shall also be unfastened and removed. Open holes in ducts, boxes, panels, and knockouts shall be closed with suitable snap plugs or blank-off steel plates.

J. The contractor shall remove demolished equipment from the project site.

1.16 CUTTING AND PATCHING

A. All cutting, patching, and refinishing work necessary for the project electrical installations shall be done by the Contractor for such work but paid for by this Contractor.

1.17 PAINTING

A. All factory finished electrical equipment shall be cleaned at completion of job. Equipment showing rust or mars shall be touched up with rust inhibiting primer and finished with enamel of color to match original finish. Paint the exposed surfaces of housekeeping pads in "Safety Yellow". Primary conduits and junction boxes shall be painted "Orange" (M-314) with labeling - "Danger High Voltage 13,200 Volts" at 48" intervals along entire conduit runs and on junction boxes. Paint fire alarm system junction boxes "red". Coordinate painting of fixture hanger rods and stems and auxiliary fixture supports with Painting Trades.

1.18 STRUCTURAL DIFFICULTIES

A. Should any construction conditions prevent the installation of switches, conduit, outlet boxes, junction boxes, conductors, lighting fixtures and/or other related equipment at locations shown on Drawings, minor deviations may be permitted and shall be directed by the Construction Manager and shall be made without any additional cost to Owner.

1.19 SLEEVES, CHASES AND RECESSES

A. Provide conduit sleeves where conduits pass through concrete floors, walls, beams and ceilings. Sleeves shall be galvanized rigid steel conduit. Aluminum conduit shall not be used. Where specific sizes are not indicated on Drawings, sleeves shall be sized to provide one-half (1/2) inch clearance around the outside surface of the item for which they were installed. They shall be flush with wall surfaces, and shall extend one inch, or as directed, above finished floor levels. The space between conduit and sleeves shall be fire stopped using one of the methods detailed in the UL Fire Resistance Directory, Vol. 2, Through - Penetration Firestop Systems, latest Edition. Seal any openings between sleeves and concrete in an appropriate manner

B. The filler materials and methods used shall be rated at least equal to the fire resistance of the construction material being penetrated.

1.21 STEEL

A. Provide all steel leveling channels required for electrical equipment and miscellaneous auxiliary structural and supporting steel required for mounting and hanging electrical equipment. All steel work used in damp or wet locations shall be hot dipped galvanized steel.
1.22 GRADE OF MATERIAL AND/OR EQUIPMENT

A. All items purchased for this project shall be new, unused material, and shall be manufacturer's first or specification grade and shall be UL listed for their intended use. No commonly call "competitive" grade fixtures, devices or materials shall be purchased or installed.

1.23 ASSEMBLY OF EQUIPMENT

A. The Drawings and Specifications make mention of numerous items to be purchased and installed and are noted by a manufacturer's name, catalog number and/or brief description. The catalog number as mentioned may not be complete to designate all the accessory parts and appurtenances required for the particular use of function.

B. Arrange with the manufacturer for the purchase of all items required for the complete installation and efficient operation of the equipment furnished.

1.24 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 shall it be construed to obligate the Owner in any way to accept improper work or defective materials.

B. All new and/or relocated lighting fixtures with burned out lamps shall be equipped with new lamps when project is turned over to the Owner. All defective ballasts shall be replaced with new ballasts. Existing fixtures being relocated shall be cleaned, relamped and refurbished.

1.25 PROTECTION, HANDLING AND CLEANING

A. Responsibility for care and protection of Electrical Work, including assigned equipment, rests with Electrical Trades until the installation has been accepted.

B. After delivery, before and after installation, store and protect equipment and materials against dampness, theft, injury, or damage from all causes.

C. Protect lighting fixtures, and other equipment with finished enamel or glazed surfaces, from damage by covering and/or coating in an approved manner.

1.26 EQUIPMENT CONNECTIONS

A. Connection to equipment, motors, fixtures, etc., shall be made in accordance with the Shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. Any and all additional connections not shown on the plans but called for by the Shop Drawings or required for the proper operation shall be provided at no additional charge to Owner.

1.27 CONDUIT INSTALLATION

A. All work shall be concealed in finished areas unless otherwise noted. Exposed work shall be installed perpendicular or parallel to walls, ceilings, and structural members and coordinated with mechanical ducts, pipes, and equipment.

B. For work in finished rooms without ceilings, the conduit shall be run exposed except as noted hereinbefore. Conduit drops for outlets, switches, etc., shall be run concealed in the wall construction and such conduits shall be concealed up to a point at least 9'-6" above the floor.
C. Outlets shall not be installed back to back, maintain a minimum of 12” between adjacent outlets. Through-wall outlets are not permitted.

1.28 ACCESS DOORS

A. Provide all access doors where required by NEC for access to concealed features of the electrical installation. Doors shall be of suitable construction and insulating properties for the wall or ceiling in which they are installed. In the walls and ceilings, doors shall be as required to make all controls, electrical boxes and equipment accessible, minimum size 12” x 12”. Provide inserts for access doors to provide similar appearance to the surrounding construction. Areas with lay-in or accessible ceilings will not require access doors.

B. Access doors shall have fire ratings equal to the wall or ceiling in which they are installed, and shall be Milcor, or approved equal. Door shall be provided by Architectural trade, but paid for by this Contractor.

1.29 DRAWINGS AND MEASUREMENTS

A. The Drawings show the general arrangement, general design and location of equipment. The Drawings are to be considered diagrammatic and are not intended to be scaled for roughing-in measurements, nor to serve as Shop Drawings.

B. Electrical Work is shown on Drawings by standard symbols. Special symbols, if used, are shown in a legend on Drawings.

C. Outlets connected by lines show switch control or circuiting only and are not actual runs of conductors. All light and receptacle outlets are lettered and numbered; the letter indicates the panel from which the circuit is to be controlled. All outlets bearing the same letter and number shall be connected to the same circuit.

D. Follow the Drawings in laying out the work. Consult Architectural, Structural and Mechanical Trades Construction Documents to become familiar with all conditions affecting the work, and verify all spaces in which work will be installed. Field measurements shall be taken where necessary, for ordering materials and fitting the installation to the building construction.

E. Where job conditions require reasonable changes in indicated locations or arrangements, such changes shall be made without extra cost to the Owner.

1.30 COORDINATION WITH OTHER TRADES

A. Install all work so as to avoid interference with the work of other Trades. Be responsible for removing and relocating any work, which, in the opinion of the Owner’s Representative, causes an interference with the work of the trades.

1.31 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 General Requirements and Section 01700. In addition to the requirements specified in Division 1, indicate installed conditions for:

1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, contract modifications, and actual equipment and materials installed.

1.32 TESTING AND ACCEPTANCE

A. When the systems are completed, the Contractor shall operate equipment in accordance with Section 16950 and Section 16995 and as directed by Owner's Representative. Replace all faulty equipment. Make necessary adjustments before final acceptance.

B. Perform all tests required by State, City, County and/or other agencies having jurisdiction, with Architect/Engineer and Construction Manager present.

C. Provide all materials, equipment, etc., and labor required for tests.

D. Provide complete operating instructions, test results, manuals and repair parts lists for the Owner's personnel as specified above. Instruct Owner's personnel in the operation of all systems.

1.33 PARTS RECEIPT

A Retain all portable and detachable portions of the installation such as keys, tools, manuals, etc., until the completion of the work and then turn them over to the Owner and obtain itemized receipt. This receipt shall be attached to the "Final Application" for payment.

1.34 PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, and approvals shall be obtained, and fees shall be paid for, by this Contractor.

1.35 CERTIFICATE OF APPROVAL

A. Upon completion of the building, provide the Construction Manager with Certificate of Approval from electrical inspection authority.

1.36 MOUNTING HEIGHTS

A. Unless otherwise indicated, mounting heights shall be based on measurement from finished floor to centerline of outlet device junction box or where applicable, to top/bottom of equipment. Mounting heights shall be as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting Switches</td>
<td>4'-0&quot;</td>
</tr>
<tr>
<td>Receptacles (General Areas)</td>
<td>1'-6&quot;</td>
</tr>
<tr>
<td>Receptacles (Utility Areas)</td>
<td>4'-0&quot;</td>
</tr>
<tr>
<td>Telecommunication Outlets</td>
<td>1'-6&quot;</td>
</tr>
<tr>
<td>Wall Phone</td>
<td>4'-0&quot;</td>
</tr>
<tr>
<td>Fire Alarm Stations</td>
<td>4'-0&quot;</td>
</tr>
<tr>
<td>Fire Alarm Signals</td>
<td>7'-6&quot;</td>
</tr>
<tr>
<td>Alarm Bells</td>
<td>1'-6&quot; Below Fin. Ceil.</td>
</tr>
<tr>
<td>Clocks/Clock Outlets</td>
<td>1'-6&quot; below Fin. Ceil.</td>
</tr>
<tr>
<td>Lighting/Receptacle Panels</td>
<td>6'-0&quot; to Top</td>
</tr>
<tr>
<td>Distribution Panels</td>
<td>7'-0&quot; to Top</td>
</tr>
<tr>
<td>Motor Starters, Safety Switches</td>
<td>5'-0&quot; to Top</td>
</tr>
</tbody>
</table>

1.37 DEFINITIONS

EPDM: Ethylene-Propyene-Diene Terpolymer Rubber.
Wayne State University  
FAB Rooftop Air Conditioning Unit Replacement  
WSU Job #130-252650  

DSD PROJECT No. 14-4802.00  

BASIC ELECTRICAL REQUIREMENTS  

NBR: Acrylonitrile-Butadiene Rubber.  
EMT: Electrical Metallic Tubing.  
ENT: Electrical Non-Metallic Tubing.  
FMC: Flexible Metal Conduit.  
IMC: Intermediate Metal Conduit.  
LFMC: Liquid Tight Flexible Metal Conduit.  
FLNC: Liquid Tight Flexible Non-Metallic Conduit.  
RNC: Rigid Non-Metallic Conduit.  

Lighting Section – Interior:  

A. BF: Ballast Factor.  
B. CRI: Color Rendering Index.  
C. HID: High-Intensity Discharge.  
D. LER: Luminair Efficacy Rating.  
E. Luminair: Complete lighting fixture, including housing ballast if provided.  

Lighting Section – Exterior:  

A. BF: Ballast Factor.  
B. CRI: Color Rendering Index.  
C. HID: High-Intensity Discharge.  
D. LER: Luminair Efficacy Rating.  
E. Luminair: Complete lighting fixture, including housing ballast if provided.  

END OF SECTION 260100
SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01

A. This section includes the following:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Common electrical installation requirements.

PART 2 - PRODUCTS

2.01 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.02 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.
B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.03 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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3.04 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500
SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 GENERAL

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.
   3. Sleeves and sleeve seals for specified cables.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Conductors & Cables Manufacturers – Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable produce by one the following:
   1. Alcan Products Corporation; Alcan Cable Division.
   3. General Cable Corporation.
   4. Senator Wire & Cable Company.
   5. Southwire Company.

B. Copper Conductors: Shall comply with NEMA WC 70.

C. Conductor Insulation: Shall Comply with NEMA WC 70

D. Factory-fabricated connectors and splices shall be of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

A. CONDUCTOR MATERIAL APPLICATIONS

1. Feeders: All feeders to be copper, aluminum will not be acceptable. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

2. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3. Feeders and breakers shall be type THHN-THWN single conductors in required raceway.

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4. Feeder Conduits in Ceilings, Walls, and Partitions, shall be Type THHN-THWN, single conductors in raceway.

5. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.


7. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

8. Cord Drops and Portable Appliance Connection: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

9. Control Circuits: Type THHN-THWN, in raceway.

B. INSTALLATION OF CONDUCTORS AND CABLES

1. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

2. Use manufacturer-approved pulling compound or lubricant where necessary; Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

3. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

4. Support cables according to Division 26 Section “Hangers and Supports for Electrical Systems.”

5. Identify and color-code conductors and cables according to Division 26 Section “Identification for Electrical Systems.

C. CONNECTIONS

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

2. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

1. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping.”

2. 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.
3. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

4. 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.

5. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

6. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section “Joint Sealants.”

7. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section “Penetration Firestopping.”

8. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.


10. Underground Exterior-Wall Penetrations: Install cast-iron “wall pipes” for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

11. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section “Penetration Firestopping”.

END OF SECTION 260519
SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL

A. This Section includes the following:
   1. Methods and materials for grounding systems and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

A. Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 and larger, unless otherwise indicated.

B. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe.

C. Provide proper connector terminations and connectors

D. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.
3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.

C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

C. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners.

3.4 FIELD QUALITY CONTROL

A. Retain a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
   1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   3. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
B. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526
SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRIC

PART 1 - GENERAL

1.1 GENERAL

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components as manufactured by:

   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.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least 1 surface. Support systems as manufactured by:

   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. Fabco Plastics Wholesale Limited.
   d. Seasafe, Inc.

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.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

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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.

2. Mechanical Expansion Anchors: Insert-wedge type stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

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 A325.

6. Toggle Bolts: All steel springhead type.


PART 3 - EXECUTION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.1 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

END OF SECTION 260529
SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL

A. This section includes the following:

1. Raceways, fittings, boxes, enclosures and cabinets for electrical wiring.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers – Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
7. Maverick Tube Corporation.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

F. EMT: ANSI C80.3.

G. LFMC: Flexible steel conduit with PVC jacket.

H. 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.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.
2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers – Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.4 METAL WIREWAYS

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type [1] [12] [3R], 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.

2.5 NONMETALLIC WIREWAYS

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. Hoffman.
2. Lamson & Sessions; Carlon Electrical Products.

B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.

C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

D. 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.

2.6 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect and as manufactured by:

   a. Thomas & Betts Corporation.
   c. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors and as manufactured by:

   a. Butler Manufacturing Company; Walker Division.
   b. Enduro Systems, Inc.; Composite Products Division.
   c. Hubbell Incorporated; Wiring Device-Kellems Division.
   d. Lamson & Sessions; Carlon Electrical Products.
   e. Panduit Corp.
   g. Wiremold Company (The); Electrical Sales Division.
2.7 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
7. RACO; a Hubbell Company.
10. Spring City Electrical Manufacturing Company.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

I. 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.

J. 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.

2.8 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.9 SLEEVE SEALS

A. Manufacturers Basis of Design Product: Subject to compliance with requirements, provide 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.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
   a. Loading dock.
   b. Mechanical rooms up to 10 feet above floor.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway.
8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway.
9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: General-use, optical fiber/communications cable raceway.
10. 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 trade size.
D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION
A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings.
B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
C. Complete raceway installation before starting conductor installation.
D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
E. 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.
F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
G. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

K. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
   1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
   2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
   3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
   1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
      c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
      d. Attics: 135 deg F temperature change.
   2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
   3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
N. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

P. Set metal floor boxes level and flush with finished floor surface.

Q. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.4 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.6 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533
PART 1 - GENERAL

1.01 GENERAL

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
4. Warning labels and signs.
5. Equipment identification labels.

1.02 COORDINATION


PART 2 - PRODUCTS

2.01 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.02 WARNING LABELS AND SIGNS


B. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
2.03 EQUIPMENT IDENTIFICATION LABELS


2.04 RECEPTACLE OUTLET IDENTIFICATION LABELS

A. Provide white tape labels with black lettering indicating panelboard and circuit number.

PART 3 - EXECUTION

3.01 APPLICATION

A. 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.

B. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

C. 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 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.

D. 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. Equipment to Be Labeled:
   a. Disconnect switches.
   b. Enclosed circuit breakers.
   c. Motor starters.
   d. Receptacle outlets.

3.02 INSTALLATION

A. Verify identity of each item before installing identification products.

B. 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:
   b. Phase B: Orange.
   c. Phase C: Yellow.

END OF SECTION 260553
PART 1 - GENERAL

1.1 GENERAL

   A. Section includes the following:

      1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers, and motor-control centers.
      2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches, fuseholders, and panelboards.
      4. Spare-fuse cabinets.

1.2 SUBMITTALS

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

      1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
      2. Current-limitation curves for fuses with current-limiting characteristics.
      3. Time-current curves, coordination charts and tables and related data.
      4. Fuse sizes for elevator feeders and elevator disconnect switches.

1.3 QUALITY ASSURANCE

   A. Source Limitations: Obtain fuses.

1.4 PROJECT CONDITIONS

   A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.5 COORDINATION

   A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.6 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with requirements:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 10 percent spare capacity minimum.
2. Fuse Pullers: For each size of fuse, where applicable and available.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses: All fuses shall be dual element time delay type.

1. Feeders Greater than 600A: Class L, fast acting.
2. Feeders 200A to 600A: Class RK1, fast acting.
3. Feeders Less than 200A: Class RK5, fast acting.
4. Motor Branch Circuits: Class RK5, time delay.
5. Other Branch Circuits: 100A to 600A: Class RK1, less than 100A – RK5.
6. Control Circuits: Class CC, fast acting.

END OF SECTION 262813
SECTIOAN 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 GENERAL

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.

1.02 SUBMITTALS

A. 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, finishes and:

1. Short-circuit current rating.
2. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.03 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 1000 feet.

1.04 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces.

PART 2 - PRODUCTS

2.01 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
4. Square D/Group Schneider.
B. Fusible Switch, 600 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 INSTALLATION

A. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

3.02 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.

END OF SECTION 262816
SECTION 270500 – COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Current version of Wayne State Standards for Communications Infrastructure shall apply to this section.

1.2 SUMMARY

A. Provisions of raceway, boxes for data, video communications systems as described in the following sections:

1. 260529 – Hangers and Supports for Electrical Systems.
2. 260533 – Raceway and Boxes for Electrical Systems.

B. Provision of equipment and wiring for these systems are not part of this contract.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 270500
SECTION 283111 – DIGITAL ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 GENERAL

A. Section Includes:
   1. Digital Addressable Fire Alarm Control Panel
   2. Duct Smoke Detectors
   3. Addressable interface modules.

1.2 SYSTEM DESCRIPTION


B. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory. The manufacture shall provide all software and hardware required, including a programmer.

C. Extend all existing fire alarm initiating and signal circuits (conduit and wiring) and reconnect to new fire alarm panel.

1.3 SUBMITTALS

A. General Submittal Requirements:
   1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
   2. Shop Drawings shall be prepared by persons with the following qualifications:
      a. Trained and certified by manufacturer in fire-alarm system design.
      b. NICET-certified fire-alarm technician, Level III minimum.

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

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

   2. Include voltage drop calculations for notification appliance circuits.
   3. Include battery-size calculations.
   4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

7. Only Fire Alarm Control Panel Equipment and the peripheral field devices have been shown on the contract drawings. Specific and complete wiring between control equipment and peripheral equipment has been deleted for clarity. Upon contract bid approval, and prior to the start of system installation, the fire alarm system contractor shall submit a complete riser diagram and layout of the entire fire alarm/smoke detection and life safety system, showing all interconnect wiring and equipment.

D. Field quality-control reports.

E. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
   a. Frequency of testing of installed components.
   b. Frequency of inspection of installed components.
   c. Requirements and recommendations related to results of maintenance.
   d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

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.
1.5 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Digital Addressable Simplex 4100 ES Fire Alarm System Panel

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Duct smoke detectors.

B. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.

4. Each sensor shall have multiple levels of detection sensitivity.

5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

# 2.3 ADDRESSABLE INTERFACE DEVICE

A. **Description:** Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. **Integral Relay:** Capable of providing a direct signal for fan, damper or door control.

# 2.4 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the Detroit Fire Department and shall comply with UL 632 and be listed and labeled by an NRTL.

B. **Secondary Power:** Integral rechargeable battery and automatic charger.

C. **Self-Test:** Conducted automatically every 24 hours with report transmitted to central station.

# 2.5 EMERGENCY VOICE/ALARM COMMUNICATIONS (EVAC)

A. The Fire Alarm Control Panel shall incorporate all necessary components for an EVAC system to be utilized once the existing fire alarm devices in the building have been replaced with new addressable devices.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. **Equipment Mounting:** Install fire-alarm control unit not more than 72 inches above the finished floor.


D. **Duct Smoke Detectors:** Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

E. **Audible Alarm-Indicating Devices:** Install not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

### 3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section “Identification for Electrical Systems.”

B. Install framed instructions in a location visible from fire-alarm control unit.
3.3 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.4 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction and construction management.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.

   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.


3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test audible appliances for the private operating mode according to manufacturer's written instructions.

5. Test visible appliances for the public operating mode according to manufacturer's written instructions.


E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

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I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

END OF SECTION 283111